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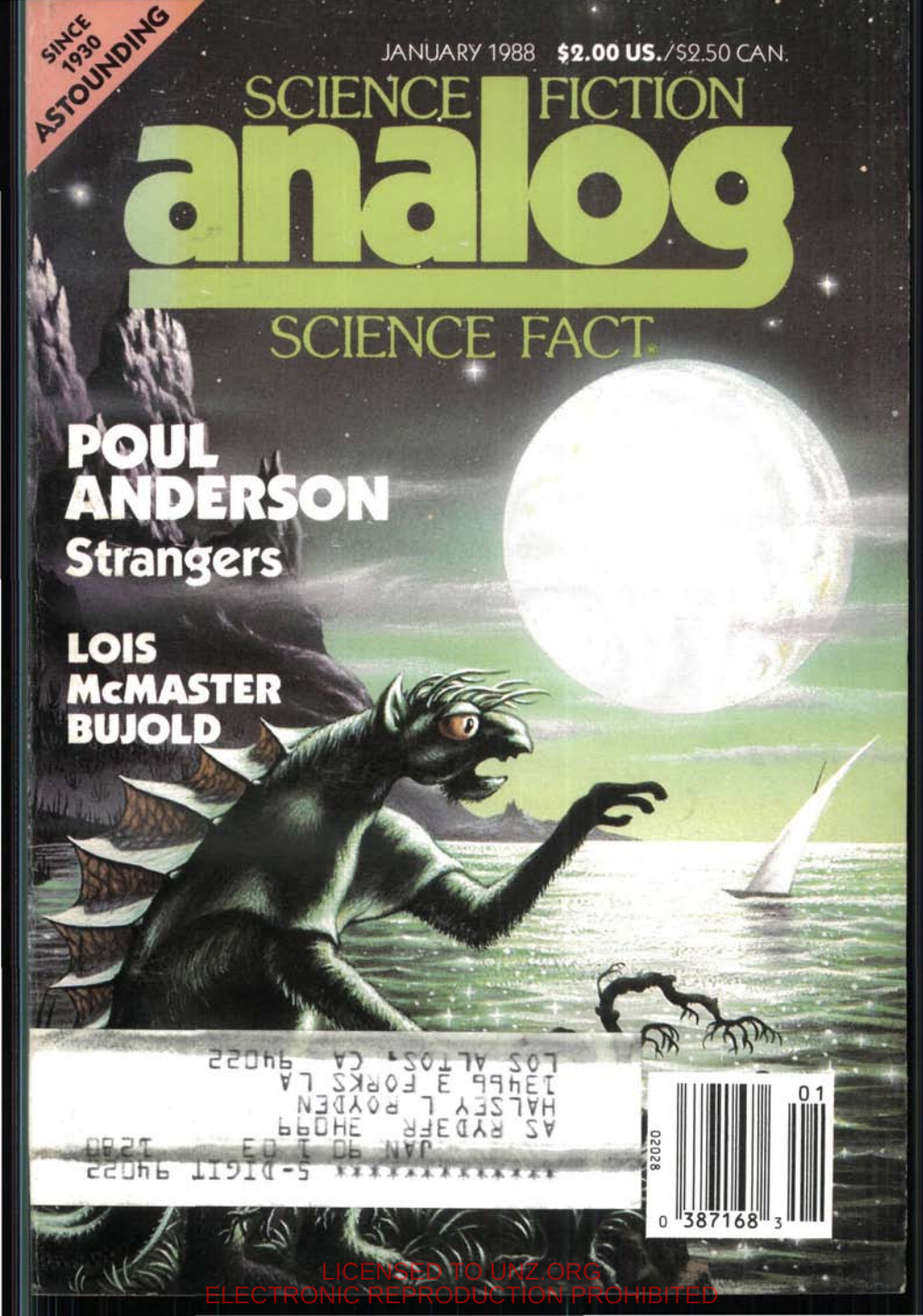

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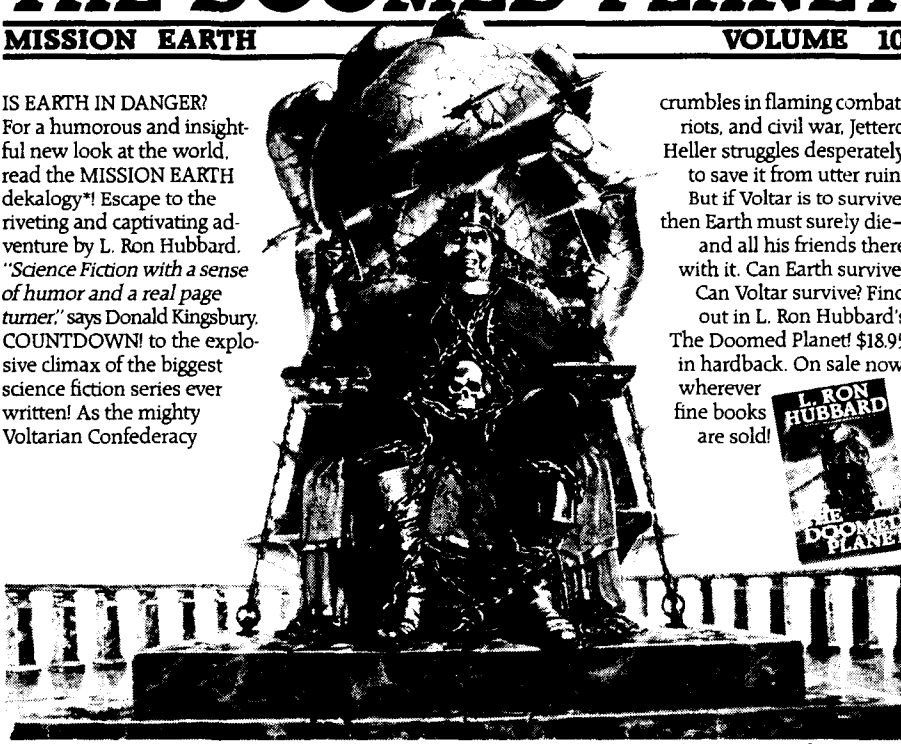

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Editorial

MATTERS OF PRINCIPLE

Stanley Schmidt

Almost everyone claims to believe, and a good many actually do, that a "person of principle" is one of the better things a person can be. Few would deny that a person who has clear ideas of what is right or wise, and consistently acts in accordance with those ideas, is more likely than one who doesn't to interact beneficially with other individuals and the civilization in which he lives.

But is it *always* desirable or beneficial for individuals, corporations, or governments to act in strict accord with the principles they believe in? Probably not, if someone happens to believe in a "bad" principle, such as "Exterminate thine enemies." But what about a principle that almost everybody agrees is a good one? Is it possible to be *too* rigidly conscientious about acting in accordance with such a principle?

The idea that open competition in a free market is good for the economy and good for consumers is a principle very widely accepted in this country. It sounds good to me, too, as a general thing. A monopoly is potentially quite dangerous, and in most cases I suspect I have a better chance of getting fair prices and good merchandise or service if the guy who doesn't want to provide them has to worry about competition from someone who does. That was, at least ostensibly, a large part of the rationale behind the recent breakup of "Ma Bell" and the deregulation of airlines.

How are those working out?

Admittedly, any significant change takes a while to settle down into a new equilibrium—but these changes have been around long enough that one might

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reasonably expect some of the predicted benefits to be apparent by now. However, most frequent flyers I know agree that service is generally less reliable and less comfortable than it was before deregulation—and so do the statistics I've seen. *Safety* has not been seriously compromised, at least so far—but there are real concerns about airlines cutting costs by cutting corners on things like equipment maintenance, and the proliferation of flights has increased delays and overburdened air traffic controllers. It is true that some very low fares are now available, but they are subject to a bewildering maze of restrictions and offset by a bizarre range of *different* fares for the same trip, the highest of them many times the lowest. Buying an airline ticket has become a lot like playing Las Vegas or Atlantic City. Assuming you get your reservation early enough to qualify for one of the lower fares, you have to consider the price, the cancellation penalties, and try to guess the odds on having to change your plans, to determine which fare is your best bet—and "bet" is exactly the right word.

As for Ma Bell and all the Baby Bells, the main effects visible to the customer so far seem to be the need to choose among companies (some with lower prices, many with service problems like unreliable connections or annoying time delays), and vastly more complicated bills. (Yes, I know some long-distance rates have gone down—but other parts of my bills have gone up, and the *overall* change is, at best, unimpressive. And price isn't everything, anyway.) Before things were improved, I used to get one monthly phone bill: an envelope containing a return envelope (requiring one first class stamp), one page to return with my payment, and one page for my files. Now I get *two* monthly bills, from two different companies, with two different account numbers (both longer than the old one), requiring two stamps, two checks, and twice as much time to pay. Each of those bills contains more pieces of paper than the old one ever did; one of them contains an *astounding* number of pages. It may be that the *most* significant aspect of the breakup is a nontrivial increase in the number of trees being cut to make all that extra paper, the energy and other resources used to process them, and the problems of disposing of all the resulting waste. True, all this creates jobs, too—but, as I have said many times before, viewing the creation of jobs as an end in itself is a very short-sighted approach that we are eventually going to have to outgrow. I've talked to at least one person who has long *had* a job within the phone system, and has strong libertarian leanings that make him think he *should* consider the breakup a Good Thing—but in practice, he has little good to say about it.

Could it be that even if free competition is *usually* good for the economy (by which I mean good for the people participating in it), it isn't *always* the best way? Might it be that in *some* cases—such as a communication or transportation system whose very reason for being is to bring some sort of unity to a large geographical region—a

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well-run monopoly might *work* better than a bunch of more or less independent units trying to compete and cooperate at the same time? Heretical suggestion for consideration: how well a system does its job may be more important than whether it does it in a way prejudged to be the best for all possible cases. Making different kinds of systems function optimally may require different approaches—and clinging rigidly to a belief that This Way Is Always Right may keep you from finding them.

Those examples are economic and deal with principles applied to big organizations. How about personal ethics? A widely professed (though rather less widely practiced) principle holds that "Honesty is the best policy." Again, it sounds good, and my personal feeling is that it's true *most* of the time. If it's true *all* the time, it greatly simplifies the

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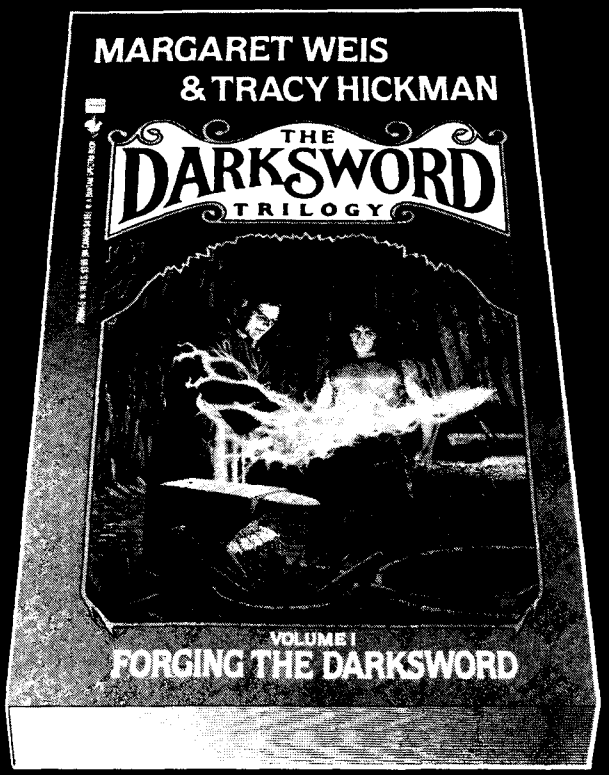

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day-to-day demands of decision-making—but does it really give the right answer in all conceivable real-world situations?

There's a scene in Mark Twain's *Huckleberry Finn* in which Huck, briefly away from the raft he is riding down the Mississippi with the runaway slave Jim, encounters a group of locals looking for some runaway slaves. When they ask Huck whether there are any men on his raft he admits that there's one. When they ask, "Is your man white or black?," he deliberates awhile and tells them, "He's white." After the slave-hunters go off, Huck feels guilty for doing "wrong," as even he has been conditioned to do. But by the only kind of ethics I can justify expecting others to follow, his lie—and it's as clearly and literally a black-and-white case as you could ask for—was the only morally defensible course.

Normative principles of human behavior—rules for personal and commercial conduct—are analogous to scientific theories, while actions in concrete situations are more like experiments or engineering applications. Despite the nonsense spouted by certain people about "mere theories," a theory is *not* just a guess or a subjective opinion, and all theories are not interchangeable or equally valid. Scientific theories are models constructed to provide a basis for understanding what has been observed to happen in the past and predicting what will happen under given circumstances in the future. Some (such as the earliest ideas about motion) neither describe nor predict well and therefore have little or no value. Others (such as Newtonian mechanics) describe and predict better and can therefore be considered better theories. Still others (such as relativity) describe and predict more accurately under a wider range of conditions and therefore are still better (but still not necessarily The Last Word). Newtonian mechanics was (and still is) quite useful under certain conditions. As long as no one had occasion to describe or predict phenomena under other conditions, there was no reason not to suppose its principles were truly *general* principles. But eventually people did observe phenomena that were not accurately described by Newtonian physics, and so it became necessary to develop a more general theory that gave Newtonian answers under Newtonian conditions, and something else under non-Newtonian conditions. An observer confronted by the new data could have chosen to ignore them and pretend they weren't real or meaningful because they didn't fit his old model, but such an observer would have no means for dealing appropriately with the new conditions. Good theories are nice to have because they make it possible to predict what will happen (and therefore what should be done) in a given situation—but what ultimately matters is what *does* happen in the real world. If what really happens is different from what theory predicts, then the theory needs to be fixed or expanded.

Moral or economic principles are attempts to formulate theories of what will produce certain beneficial or harmful effects on individuals or societies. Their

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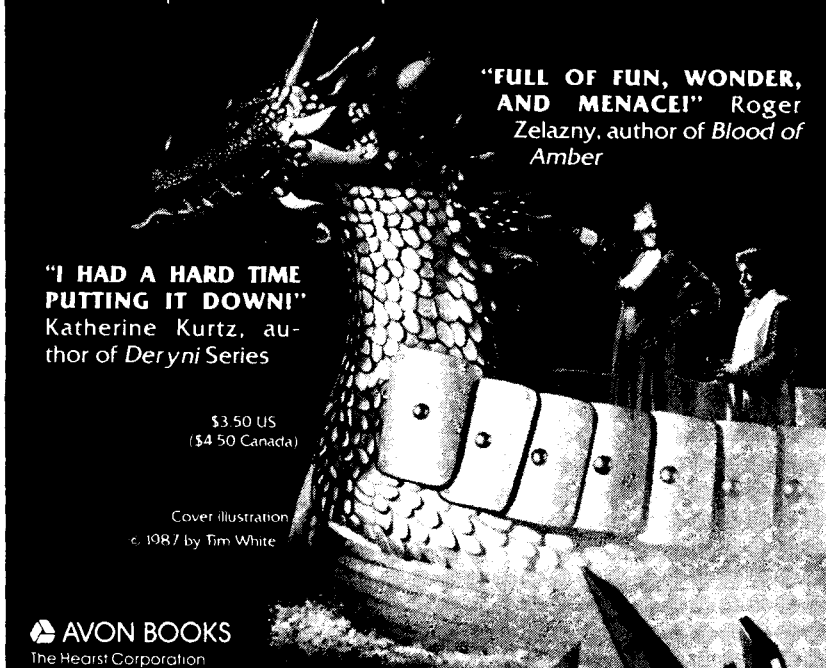

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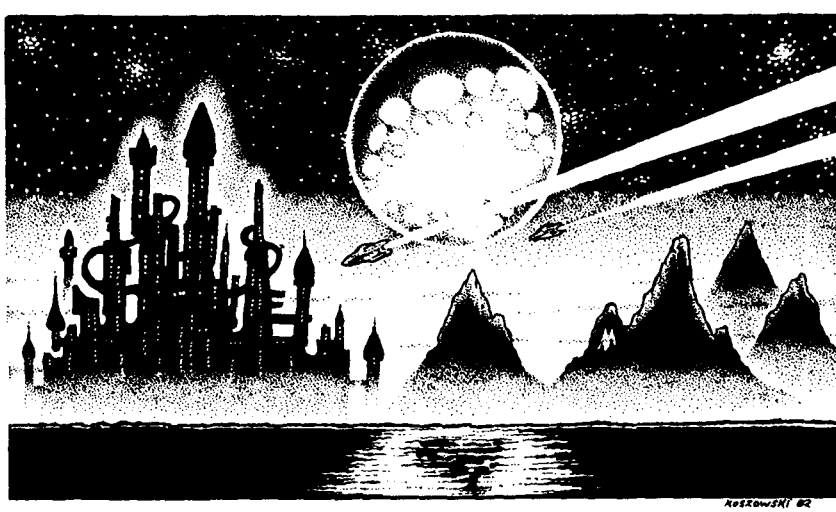
"engineering" applications are actions taken on the basis of those theories for the purpose of achieving beneficial and avoiding harmful effects. If the actions taken fail to produce the results predicted by the theories, even if they have done so under other circumstances, then those theories—those principles—must, like any other theories that fail to predict accurately, be modified and improved.

Sticking to principle is fine—if the principle is soundly and generally formulated. But the best theories *evolve* from less satisfactory ones. Scientific theories are not formulated in the best or most general form on the first try, because all possible situations have not yet been observed. As new ones are found, theories are refined to cover them. I see no reason not to expect this to be true of ethical and economic theories as well.

An individual or society *needs* principles which will reliably suggest beneficial behavior under most circumstances. But sometimes a person or society clings stubbornly to its present principles—its ethical or economic theories—even when they clearly don't work in a new situation where they *need* to work. That person or society is much like a man who still insists that bumblebees can't fly, because some theorist once overlooked a key variable and "proved" they couldn't, even when one is flying in his face. ■



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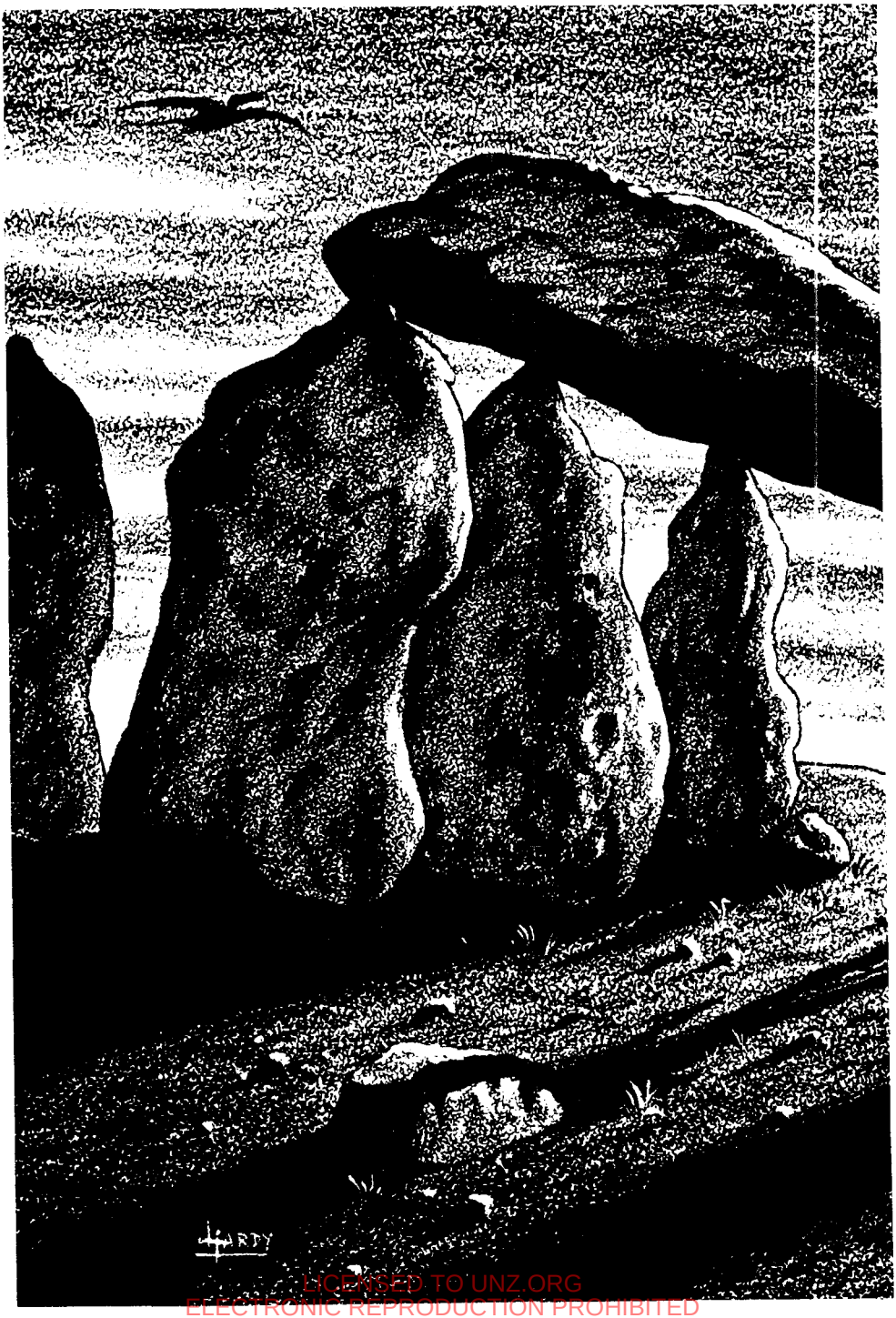

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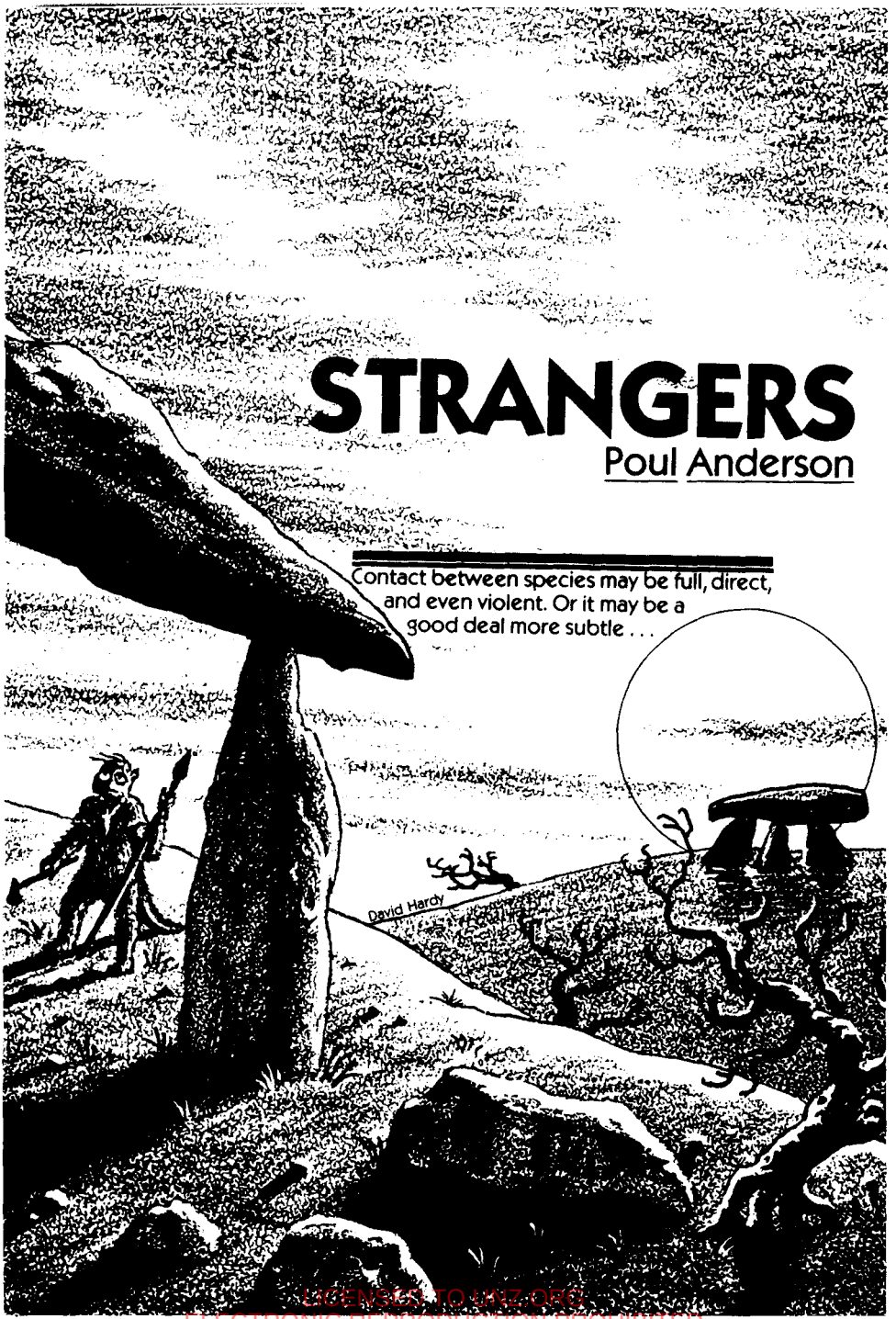
STRANGERS
Poul Anderson
Contact between species may be full, direct, and even violent. Or it may be a good deal more subtle . . .
David Hardy

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Last night as I stood on the clifftop at Hrau, seeking dreams, a ghost sailed by. The moon was well aloft, full, so bright that it flooded most stars out of heaven, for clouds had whitened nearly all its face. The light shimmered over darkful waves as if to make a path to Lost Motherland. Afar on my left, the northern horizon flickered with the campfires of the dead.

Wind lulled and ruffled my fur. It was cool, and full of salt odors to which my tendrils quivered. The surf broke utterly white, so far beneath me that the sound came low and steady, like the murmur of First River on its way to the sea when I was young. Here was a good loneliness in which to hope for dreams that would help me understand what this life has meant that now nears its end. I had not thought myself to be the kind that does—I am no saint or familiar of the Unseen—but the Watermother says I should, because of what happened long ago. Aia, how long ago!

Then as I waited, something glimmered yonder. It might have been a leaf, pale with autumn, which the wind hunted along the foam-crests. Yet it was too large, and fared too steadily, and it came not down the wind but across, from the east. Was this the form of my guide into sleep? A shiver and a shiver passed through me.

Still it neared, until suddenly it swung about. By that time it was so close that I could see what was below, the knife-lean shape cleaving its way, with a wake behind on which the moonlight shattered and swirled. My fin, already lowered, shut itself hard against my back. That was no canoe of ours passing by. That was a boat of the Night Folk.

Why have they come to seek us out, after these many years? What has changed in the Forest or in Lost Motherland, and is it of horror or of hope? Almost, I called out, but fear choked me and I crouched down, not to be seen against the western stars and the Sky Flow.

The ghost boat sailed on in swiftness and silence, following the shoreline but well clear of the breakers. As it moved away, dread left me. Might those be aboard whom I had known? I sprang to my feet, raised my fin to the full that moonlight might gleam off it, shouted and sprang about.

The boat sailed on. I do not know if they saw me. Surely they could have, as great as their powers are; but I do not know. The boat vanished southward. Grief welled up in me. I dropped to all fours, my tail lashed to and fro, I wailed for my loss, if it was indeed a loss.

No dream would come to be before dawn. Presently, though, calm did. I rose again and sang the song of farewell. After that I went home. Today I tell you of this that I have seen.

Most of you are young. You have heard the tales and learned the songs, but you do not know Lost Motherland as we few aged do who were born there and once walked on the downs and offered at the ancestral tombs. And I alone remain of those who ever saw the Night Folk. I alone sought them out in the Forest. We who remember have paid the price and suffered that loss which mortals must who deal with them; but mine was the sacrifice over and above this. Therefore you others do not know what you believe you know. I must try to tell you. Hear me.

It may be that the ghost boat was

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bound past on its way to some mystery beyond sight. It may be that the Night Folk have many times flitted about these islands unbeknownst to us. Did I only chance to see last night, or did they want me to see? That may have been the sending I sought, to make me ready; and after I am in my dolmen they will come by moonlight and whisper to me. Who can say? If they do seek you out, you will need the awe, the wariness, and also the eerie gladness that were ours, not as words but deep in your dreams. It is for your children and their children, who will not have countless ancestors to watch over them as we did, but merely us. Though you believe you have heard my story before, you have not really. Hear me.

For two days, people at home saw smoke drift up in the distance above Gneissback Fell. Ktiya had been a large thorp; it and its croplands were long in burning and longer still in smoldering after the Charioteers torched them. The sullen sight brooded behind us through our return to Oaua and haunted the following sunrise. At last it grew thin and the merciful winds scattered what was left. They could not blow the memories out of us, nor the forebodings. Ktiya was large, I say, and it had gotten the help of such other Wold People as spied the beacon fires that meant Charioteers were on their way to it. Nevertheless Ktiya perished. Oaua was small; and belike it would stand alone when next the destroyers came, for our kindred around the land would be in despair.

"But we drove them off, Ak'hai'i," my oath-comrade Izizi protested when I forced myself to utter this. "We killed several and hurt more—as you know better than anyone else among us—until they wheeled about and lashed their ehins to full speed eastward."

"They were a small party," I answered. "We had thrice the count of them, I think. Even so, they left our dead and wounded wide-strewn. They withdrew in good order, taking their own fallen along, except for those two it happened we surrounded."

"You should sing of that, Ak'hai'i," he said.

I might well have, for it was I who led the charge that split the enemy line. We cut a single chariot off from the rest, and Ngi of Thunder Bay put a spear in the driver but it was I—I—I who sprang up over the rail and killed the warrior himself. My ax smashed his head before his blade gave me more than a shallow slash, and now that blade rested sheathed upon my breast.

But darkness had risen in me with the smoke of Ktiya. "They rallied at once," I said. "They could have cloven us asunder and hunted us down one by one as we fled. They did not, because it was not worth their trouble. They had done what they meant to do, and longed to get back to their horde."

We lay in the Male Lodge, we who had gone forth to battle and lived. Soon we would seek the females and their wisdom, but first we must come to terms with those of us whom we had carried home for burial, and with ourselves. Afterward we would explain as best we could to the females, and take counsel, and all together try to come to terms with the Unseen. Thus did the Wold People do in the old times. It is different today. Everything is different.

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Coolness dwelt within the thick clay walls. Sunlight filtered through the matting in the doorway to make dusk for us. The thatch smelled of nightwort and dry forage, a peaceful smell. Our gaze we kept on the lampflame on top of the Block.

"What was it, then, that the Charioteers came to do?" asked Ngi. He and his family lived by themselves, strandfishing or venturing out into the bay on a raft more than they worked the soil. Therefore he had not heard as much as we did in our thorp, and until this moment, time and breath had been lacking for him to learn.

"To lay waste," I told him. "They have cleared that vale of people and crops. Naught will meet them when they return but the whistlewing above and the wanderbeast on the ground. Naught will be growing but forage for their herds. In this wise, piece by piece they take the world away from the Wold People."

"What drives them to such deeds?" Izizi cried.

I shrugged my fin. "Who knows? Maybe not even themselves. Or maybe the years have worsened still more in the far east than they have here, as the sun slips from her rightful path."

"They fall on us who never harmed them!"

"A flippertail may think the same of me when my net hauls him from the water," said Ngi harshly.

"They have the power, true," breathed from me, "the chariots and the iron." So did we call the terrible material that cut and stabbed, unbreakable, keener than the finest-knapped sharpstone. Nobody knew who first named it. The Watermother said the word might have come from the users. Sometimes they bore off captives, and maybe a very few of these had escaped over the years and made their way back.

"If I did," rumbled Ngi, "I would use it against them just as they do against us."

"But the fate is otherwise," I replied. "Now let us be silent, mingle our spirits with the lampflame, and find peace."

Stillness fell. It did not in me. I lay there with rage on my right side and grief on my left. What to do? At heavy cost, we had slain four or eight of a raiding party and I had brought back a weapon of theirs. What good was that when the horde had blades like stalks in a swale and we knew not how to make a single one?

At last I drew mine. The others were rapt and did not see. I looked at it and felt of it as I had done whenever we stopped to rest while homebound. It was almost as long as my arm, but at the middle no more thick than my outer thumb. A stone blade shaped like that could only be for ceremony, would shatter in use; the iron did not even chip. It sheened darkly, ice-smooth. The edges, which drew blood if I stroked them, had the beautiful curve of a sunseeker leaf. There was a guardian crosspiece at their top. The haft beyond was not merely wrapped, it was a thing to itself, carven hardwood somehow fastened on and wrapped with leather, flaring out to a knob in which was set a crystal. When I lifted the weapon, it was heavy as stone, but so balanced that it came alive in my hand. The crystal gleamed in the dusk, an eye that watched me like the eye of a beast of prey.

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For I was the prey. My people were. Surely I was not the first who ever won an iron blade for himself. It must have happened here, and there, as our kind met the invaders. But what was the use? Unskilled, its possessor would fare worse in his next battle than if he bore familiar arms. Better he leave his prize behind in the tomb of his ancestors, to wait for him. Better still, maybe, that he sink it in a pool or thrust it into a hilltop. The Unseen might accept such an offering and grant peace of soul, or the Night Folk might take it and be pleased enough to give his kindred some small help.

The flame on the Block wavered. It called me, and my spirit followed. I came back to my body knowing what I must do.

In those days the Watermother of Oaua was Riao, old, wise, and deep in the mysteries. When I told her of my intent, we two alone in her house, she said more quietly than I had awaited, "This is a wildness in you."

"It is a hope," I answered. "I see none other."

"You are likeliest to find death or worse, you who have wife and children."

"I go because I have them."

"What is your plan?"

"None. How can I make any when I know naught? I will seek until I find the Night Folk, then I will beg of them or try to compel them, whatever seems best. There are tales of ancestors who had to do with them. My own grandmother saw one."

"They flit from the Forest, across the Wold, sometimes—oftener than we know, I think," Riao agreed. "Most people who have a glimpse are afraid to tell of it afterward. If you must venture this, why do you not rove the darkness closer to home?"

"How can I be sure I will meet any, though years pass in waiting? They come and go like the wind. Or they may well spy me and stay clear of me. Also, should I catch one, their anger may fall on the whole thorp; they may blight the crops and put a murrain on the livestock. By myself, off in their own country, I may well draw them, and they should understand that any offense against them is mine alone."

"That is well spoken," she said, "and you have hunted in the fringes of the Forest, at least. Depart, keep silence, and let me dream on this."

I left that dim hut behung with strange things and went to my home. When I entered, Hroai looked hard at me and sent our young outside. "Your fin is nearly white," she whispered. Waves of violet pulsed between the ribs of hers.

"It is in my mind to brave a certain danger," I told her.

"Again?"

"This is not another battle. It would be unlucky for you to hear more. Have I your leave to fare?"

She was a long while mute, though her fin darkened and lightened and darkened, her tail twitched, her fur stood briefly on end. At last she said, "I believe I know what you intend. For the children's sake, I will not speak of it. For good or ill, there is a fate in you. Let us have each other while we still may." And that night she loved me often and fiercely.

In the morning I went back to Riao. "You shall go," she declared, "but first I will teach you and give you that which

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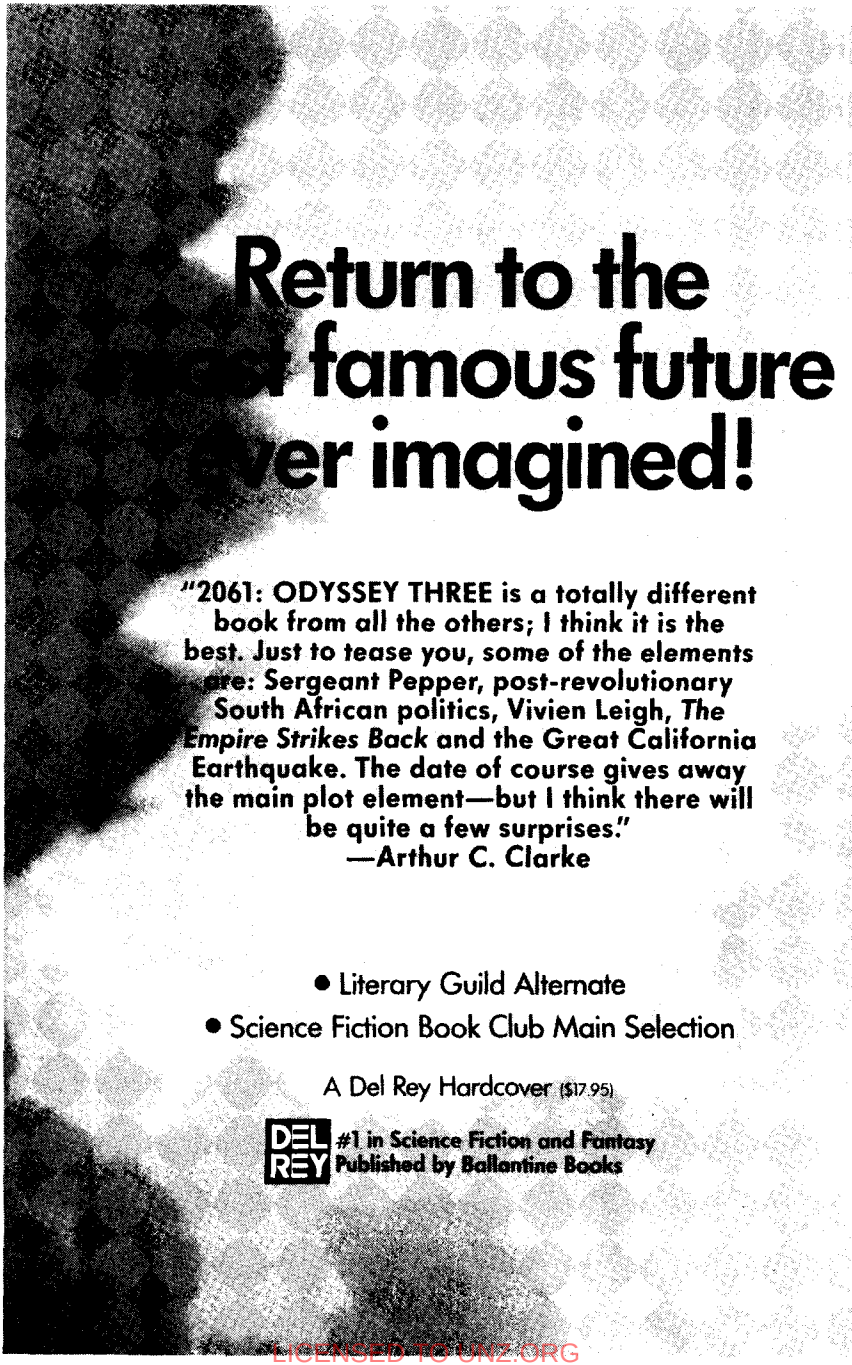
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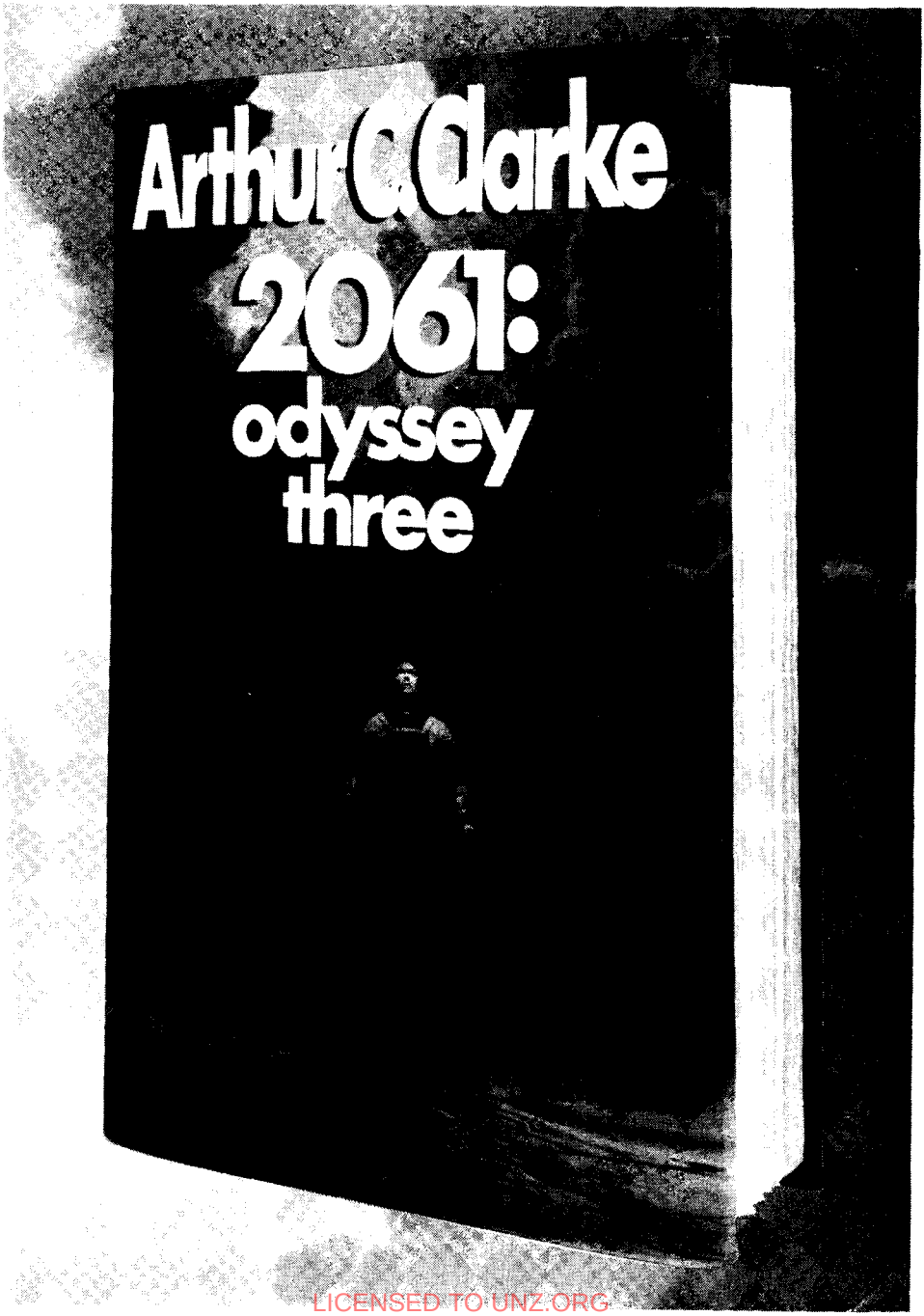

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may help."

And so I abode with her for three days and nights. What she taught me I may not reveal, only that certain signs I could watch for and certain spells I could cast were therein. At the end she took me to First River, where it cascaded into a shadowy coomb otherwise forbidden to males, and purified me. After that she gave me a lasso. "The groundvine whose fiber is in this grew on the tomb of my ancestors," she said. "I twisted it together by night, singing moonbeams in among the strands. It may bind one of those whom you seek. Be on your way."

"Let me return home and make my farewell," I asked.

"You dare not," the Watermother said.

Dawn was breaking above the mist and clangor in the hollow. I prostrated myself before her, rose, and climbed out to begin my journey.

From a hilltop I looked widely across the land. That sight is before me as I tell of it, clearer and more colored than this around us; but I was young then.

Shadows reached long and blue in the morning light. They brought forth the strong curves of the Wold, the downs rolling away and away on every side until I saw a thin gleam in the west that was the sea, the vales between their slopes, the river winding and shining through a web of lesser streams that trickled or tumbled to mingle with it. Autumn-tawny the land was, save where cultivation made small dark patches. A few scattered trees stood northward, stunted and wind-gnarled, forerunners of the Forest. Dolmens and passage graves brooded gray on heights.

Tiny and very dear was Oaua, the round huts clustered close together, hearthfire smoke seeping up out of their thatch. Hurdle-fenced pens encircled it like a lover's arms and legs. I knew the bustle and clatter of awakening, I knew that Hroai was already out in our fleshroot field with her digging stick while little Uo fed the animals and littler Lyang cleaned house and cared for the infant yet nameless, but none of this could I hear or see from where I was. I whispered, "Farewell," and started north.

The weather was chill. Even in the afternoon I needed only half unfold my fin to stay cool. Clouds drove low on blustery airs. It should not have been so. The sallowness of forage and shrubs recalled a wet, cold summer. When my mother was a child, snow seldom fell in winter; now most years saw several nights of black frost.

Late that day, following the river upstream, I came upon the Henge. I did not linger; those standing stones were too grim. The Wold People no longer met there for rites, as my grandparents had told me they once did. It was not that we believed a curse had fallen on the halidom. But when a watcher stood on the Flagstone at solstice, the sun did not rise above either Altar of the Seasons. Sacredness had gone after the heavenly paths turned awry; and weather bleakened and presently the Charioteers began arriving.

Nevertheless this remained a good land, Motherland, and I would keep it for us if my fate had might enough. So did I vow, then.

At eventide I made camp. My plan was to enter the Forest when the moon

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was full. Belike it would give more power to the Night Folk, but it would give sight to me. Meanwhile, though, I would use the dark for resting. I cut some withes, fashioned a weir, and staked it in the stream hoping my breakfast would be there at sunrise. I kindled no fire, which would have been troublesome to do and might draw a heed I did not yet want. Instead, I found pebbles to serve as a henge around me, within which I unrolled my blanket hide and ate of the dried provisions I carried.

Besides these things, I bore a casting spear and my ax: the weapons in my hands, the skin and pouch on my shoulders. A knife hung on a cord at my throat. Should any of my gear break, I could readily replace it, for sharpstone was plentiful on the Wold. Moreover, across my chest lay the iron blade, with Riao's lasso wrapped about its sheath.

I slept lightly, and my dreams were of home. I did not know what that meant.

Trees became more and taller as I trotted on. By the third day I had truly entered the Forest.

Most that grew around me were stonewood, their ruddy boles soaring aloft till the branches arched in leafage that tented off the sky. Sunlight filled the shadows overhead with flickery turquoise and the shadows beneath with white flecks. Distances reached boundless, for sight soon lost itself yonder. In places I saw bluecap blooming upward, low nightwort, moonfruit aglow, a tangle of groundvine, fangthorn crouched cruel; but mainly it was clear between the trees, except for old leaves that rustled underfoot. Sometimes a whistlewing flew from a bough, a redflit piped, a buzzbuzz blundered past; and when I stood still a while and listened closely I might hear scuttering go through the brush. Such noises hardly broke the stillness. It was warmer here than out on the Wold, and full of earth odors.

I had ventured this far in the past, hunting uk'ho or trihorn. Thus had I once come upon a field of the Night Folk. Others had done likewise. Always we called aloud that we purposed no trespass, and veered off. Today I must do what I earlier denied. I touched the rope that encoiled the blade and hastened onward before courage should bleed out of me.

My course took me from First River and the comfort of open sky above it, for here the land began to climb. The fields had been in damp, shady places. I followed a tributary brook up its own stream. It glided slow, dimly aglimmer. Shadows thickened. Evening was nigh when I found what I sought.

All those clearings were small. I think this was to have trees close around, that they might keep full sun off the witchplants. Much water was needed too; the brook ran through the middle. High and strange and in straight rows grew the plants. When last I saw them they were brilliant green, but that was in a different season. Now they were nearly white, had dried out, and bore long berries encased in husks. Four trees rose in their midst, dwarfish and gnarly. Leaves of a paler green and large red fruits clustered upon them.

I touched naught. Stories told of reckless hunters who had stolen from plots like this. They hoped the trophies would bring luck, but only misfortune came to them. A child of one ate, and although the taste made him spit it

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straightway out, he was sick for days. And then there are tales of Night Folk who visited wise females, talked with them, sometimes warned that something people were doing was unwise, but refused any food offered, or any drink save water. It alone may pass between the worlds without bearing death.

Casting about, I found what I had not found earlier, when I merely stared and fled. A trail ran along the farther side of the clearing, in easy curves that soon went beyond my sight. It was no game track, but wide and hard-packed, kept clear of growth. Peering close, I made out marks in the dirt, grooves that ran side by side about two tailspans apart. Wheel marks? Who had taught the Charioteers?

I flinched from that question and looked for a blind. A canebrake at an opposite corner of the field seemed best. I settled myself within to wait.

The sun sank until its beams speared through rare breaks in the wall of woods, as long as my thoughts. When would the Night Folk arrive to see to their harvest? Could I abide for that? What should I do? What would they do? The songs and the stories told how ill it was to cross them. Yet tales also went of kindnesses they had done, wonders they had worked, when the mood blew into them. These happenings took place in olden times, when they came out more freely upon the Wold and it was not unheard of for people to encounter them. No living person in Riao's knowledge had done so, aside from glimpses. She knew not what had changed or why. One story said that a powerful Watermother grew overweeningly proud and took such a visitor captive by spells and force; she met a frightful end when others appeared in her doorway, and afterward they never guested anyone. Many more stories said that to have anything to do with the Night Folk, even though it was help they gave, cost heavily; some said the price was half one's soul.

Nonetheless I meant to dare it, for next year the Charioteers would be back.

The sun went down. The moon rose, but the Forest shut it off. Darkness weighed on me. Its creatures hooted, chirred, and thrice from afar howled. I sat on my tail as moveless as I was able. At last I dozed.

A new sound brought me fully awake. For a moment I was aware of thirst. Time had worn on until the moon was over the treetops around the clearing. Fear thrilled everything else out of me. What I heard coming from the west was the beat of ehin hoofs.

The moon stood huge. Its clouds covered entirely the mottlings on its face. Light frosted leaves, poured down them to drench the field and melt into the brook. The edges of things were stark, the shadows they cast were dappled. Air had gone cool and still. The water whispered of secrets.

Hoofs thudded. He of the Night rode forth from under the trees.

Rode. His ehin did not draw a chariot but stepped as proudly and gracefully as if in the wild, with him upon its back. Bewilderment whirled in me. How could this be? Then I remembered that the Night Folk have no tails.

Tall he was, tall as I am long from muzzle to tailtip, and slender. The moonlight revealed him moon-pale, without fur; but hair grew in a fallow mane on his head and in a bristle on his lower face. That face was flat, save that

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the eyes were deep-set (and no tendril fronds above) and a beak jutted outward. The ears were small and round. No fin grew from his back. You have heard weird rumors of how the Night Folk look. This is the truth.

He came to the edge of the field and drew on cords he had fastened about the ehin's head. The animal halted and he sprang down to earth. I saw that he had bound a kind of seat to the ehin's back. . . . Aia, I forgot most of you have never seen such a beast. Like many large four-footed creatures of the mainland, instead of a real fin it has a low ridge of ribs and membranes along neck and back. A pad flattening part of this is harmless; the female does it to the male when she mounts him in breeding season.

My gaze went wholly to the rider. He stood as straight as he sat, needing no tail to balance himself. Through me flitted a wondering: what did he use when he must strike a heavy blow and had no ax? At once I asked myself: what would dare attack him?

I would, if I must.

The rope felt slippery as I unwound it and made a coil to carry in my left hand. My right was empty, ready to snatch out the blade, for my stone weapons were surely of no avail here. Did cold iron have power against Night Folk? Or had they made a pact with the warriors of the east, teaching them about iron and wheels? That thought stiffened my will.

He entered the field, handling the witch-plants like any farmer who wants to see how the crop ripens. Somehow that made it all the eerier. What would his harvest be? I raised my courage and trod forth into the moonlight.

He heard, turned about, stood for an instant as though startled. I lifted my right hand. "Hail to you, strong one," I heard myself call. "Forgive that I trouble you. The need of my people is great."

I stopped. The ehin stamped and whistled. For what seemed a very long time, he of the Night stayed moveless. Finally he walked toward me. You or I could never do that gait. A tailspan away he paused, and we were silent before each other.

"I am Ak'hai'i of Oaua," I said when I became able. "Lately the Charioteers came as near us as Ktiya and laid its territory waste, in spite of the Wold People who live within sight of its beacons sending males to help. Next year or next, they will be upon us. After that, year by year, they will take all for themselves. The last of us will lie untombed and none be left to light the ancestors home on Hallows' Eve. To come to you was my choosing and nobody else's. But I beg you, help us."

His mouth, below the beak, opened. The teeth that gleamed in the moonlight were like none I had ever seen before in person or beast. As he spoke, his mouth writhed around them. His voice was an eldritch singing, full of overtones and sounds we cannot make; and it changed the sounds we can make until I barely knew what they were meant to be. When I was small, my father had a tame redflit that could say a few words. They were less alien than what I now heard.

And these words stumbled. I hear them anew, even as I see that moon-washed space, the light like rimefrost on the crowns of trees and in the murmurous water; even as I feel the cold

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that went through and through me. "You . . . people . . . never . . . come . . . so."

"Death drove me," I pleaded. "You know us of old. Our ancestors remember you. Help us, lest we die!"

He spread his hands. Each bore an extra finger, and only one of the curiously shaped five was a thumb. Or thus it seemed. "No can help," he said. "You go."

I braced myself foursquare. "You must."

He pointed at me. "Go."

I stood where I was. No lightning blasted me, no curse withered me. He backed off a step. Was he afraid? That could not be, could it? He was immortal.

Yet the tales told of bounds upon what they did when they might well have done much more. And why did they shun daylight?

He moved toward his ehin. Belike he had wand or weapon tied to the animal. If I did not act at once, I could soon be dead—unentombed—or stricken mad or turned to stone.

Before fear froze me, I whipped the charmed lasso upward. It whirled about my head and pounced. I am a hunter. I noosed him by the legs, hauled, and brought him to earth.

He shouted and struggled. I leaped close and tossed coil after coil around him, snugged them taut, made him lie trussed like a taorhi for slaughter. I secured the bonds and had him.

He glared. Moonlight glistened off the white that was in his eyes. "Let me go," he panted. "No can help."

"I think you can but will not," I answered. "Or your folk can. We shall see."

He stiffened and defied me. "What you do?"

Dismay winged through my spirit. How indeed could I compel the Night Folk? What doom had I already brought on myself?

Nevertheless . . . he lay there snared. He spoke poorly, must be ignorant of speech, he, the lord of lore. None of his brethren had come on the wind to save him.

Through the awe that held me glided a thought. "You shall lie where you are till daybreak," I told him.

He gasped. Emboldened, I bent low to look closer at this that I had, incredibly, captured. What I had taken for skin wrinkled and folded with his movements. I forced myself to feel. It was covering, like a cap we put on in the bitterest weather, though this was woven so fine that warp and woof were lost within it, and was fitted to his limbs.

I drew the iron blade. Its living heaviness became my own will. "You shall have no shade from the sun," I threatened. Carefully, I slashed. His true skin shone bone-pallid under the moon. When I tugged at the fabric to get it clear of the rope, it ripped. I peeled him from shoulders to hips and left his belly naked to the sky.

What I then saw struck me with such astonishment that I dropped the blade and sprang back. "But you are female!" I cried. What evil had I been about to wreak?

His mouth twisted upward. A wild barking noise broke from him. "I male," he choked.

I mastered myself again and looked harder. Indeed that which sprouted between his thighs did not much resemble the female organ. Were the Night Folk

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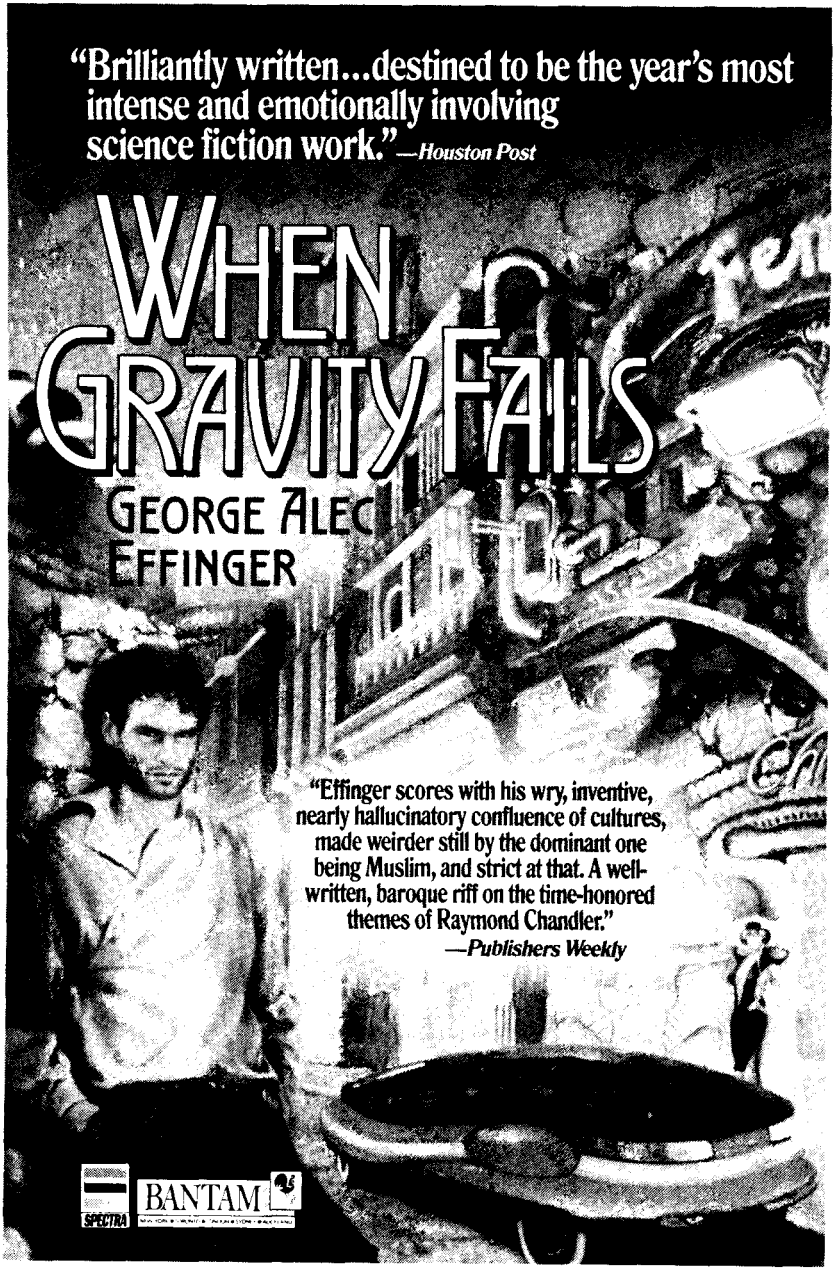
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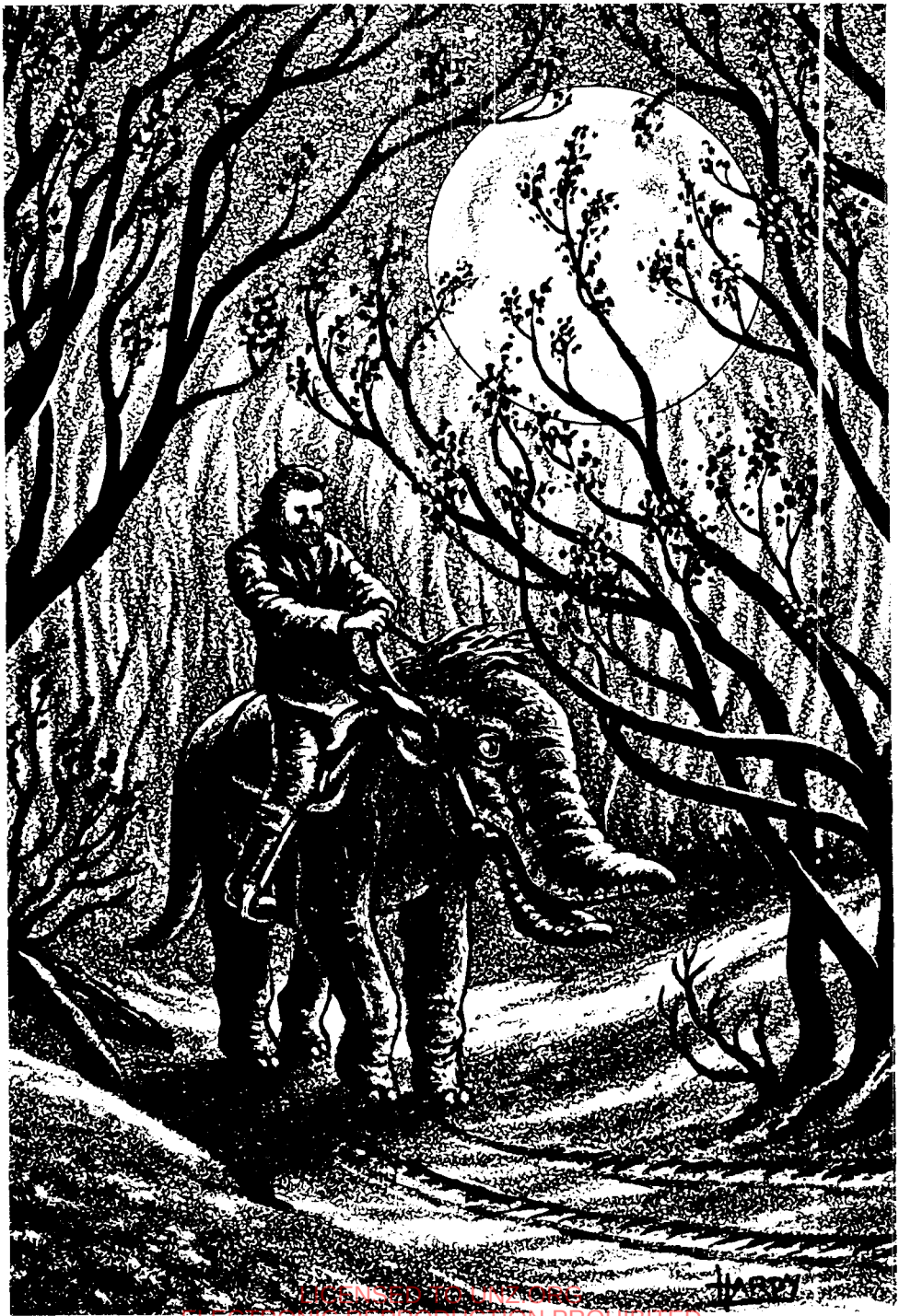

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wholly deformed?

It came to me how unwise he had been. Had he let me believe him female, I might well have released him. The Charioteers kill everyone, but the Wold People respect the Life Power.

Or would I have set him free? He was not of my people, and their need was great. I did not know, and it did not matter. He *was* male; and he was not clever, regardless of what he knew. He was mine, unless and until his vengeful rescuers arrived.

He keened words in his own language, if that was what they were, and strained against his bonds. I stood by. Dawn was still far away. Patience was my single strength. I must be the rock that outlasts the night wind.

But it was just a short while before he calmed. His uncanny gaze met mine. I compelled myself not to look away. "Sun kill me," he said. "Sun, fire, burn. I dead."

"Unless you help my people, they are dead," I answered.

"Not know how."

"There are those among you who do." I must believe that. "Take me to them."

Silence brimmed the well of moonlight that was the clearing. My spirit was cold. At last he said, "I take you."

The cold became a rushing tide. "Will you swear to that?" I asked. "By the honor of your ancestors, will you bring me unharmed to the home of your folk and will they hear me out?"

He bobbed his head up and down. "I take you, I take you."

That was no oath. Maybe the Night Folk could not swear any. Maybe, immortal, they lacked ancestors. Well, if he intended treachery, my hope was lost anyway. "We will go," I said. Stooping, I undid the knot.

Meanwhile I commanded, "Hold still." He obeyed. I kept my blade lying ready to stab while I drew the lasso off him and used it to tie his hands behind his back. He rose, and for a little while we stared again at each other.

"I . . . Sten," he said. "Sten Granstad."—as nearly as I can make the sounds.

Did he offer me his name for a hostage, as I had offered mine? My throat shut tight. It was a moment before I could repeat, "Ak'hai'i" and his gesture.

His mouth curved, though he did not bark. "Come, Ak'hai'i," he said quite softly, and turned about.

I did not risk breaking the spell by fetching my gear from the canebrake. If ever I started back home, it would be easy to chip out a hand ax, and that would be enough for the journey.

We walked west down the broad trail. He had me lead the chin by the cords. My other hand held the enchanted rope that leashed him. As time and distance passed, my grip eased. He had made no trial of escape, nor done anything else to alarm me. He gave no sign of wrath at my binding him and spoiling his garment. Rather, he went by my side almost as a comrade might.

Of course, we were bound for his kindred, and once among them I would become the captive. What I had gained was, at most, the right to speak with them; and my gain could well prove to be no more than death, and helpless homelessness forever afterward.

Only our footfalls and the chin's hoofbeats spoke while we followed that moonlit path. The shadows shifted,

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shortened; dew began to glitter on boulders and fallen trees; coolness deepened toward chill; stars trekked across heaven. My thoughts were few and dreamlike. I had gone beyond myself as well as beyond my world.

We passed more stands of witch-plants, and once a shelter. It was of wood, timbers shaped to a fineness no sharpstone adze could achieve. The form was square-sided, altogether foreign. And yet that was ordinary naoi wood.

My dream broke apart like dawn-mists when suddenly hoofs tramped ahead of us. Sten's chin whistled. We halted. I stood stiff, awaiting my fate.

It happened the boughs here were thin above us. The moon hovered enormous behind their lattice. Its light poured over the trail. Around a bend, out of the speckled shadows, another mount came into that hueless brilliance, and upon it another of the Night Folk. Behind paced two beasts of unknown kind. Four-footed, they stood about as high as my hip. Thick hair covered them from long muzzle to short tail. When they sensed me and growled, fangs gleamed.

The rider stopped, stared, reached for something. "Nadia!" Sten called. The rider drew a hollow cane of iron from a sheath and pointed it. Sten spoke fast in a lilting language that no throat among us could ever form, unless partly and brokenly. The rider replied. I stood awaiting my fate.

Sten turned to me. "Nadia Zaleski," he said, and made a gesture with his head. I cannot speak it any better than that, but I knew it was a name. He barked and added, "She female."

In truth? I stared. She too had covered her body, but I could find some differences. Her mane was black, longer than his. Apart from the thin lines of hair the Night Folk have above their eyes in place of tendrils, none grew on her face. Her form was smaller, slighter, rounder, with twin swellings at the chest. Had they not told me, I would have taken her for the male, him for the female. But they did give me this knowledge into my hands, and therewith a brightening of hope.

I stepped behind Sten and loosed his arms. "Is she your Watermother? I asked unsteadily. "If so, I will beg of her."

Nadia spoke from her seat. Although she could not make words of ours sound right, they flowed much more readily, in a voice more high and sweet, than his. "We have no Watermother," she said. "You have wandered far from your world, Ak'hai'i."

"But surely you have traveled into ours, mighty lady," I had courage to reply.

She moved her head up and down. The mane rippled about her shoulders. "I have that. What is your home, Ak'hai'i?" When I told her, she murmured, "It is long since I was in Oaua. You cannot have been born. But I met with its Watermother—secretly seeking her out, lest fear of me make her people dread her too—and we spoke of many things. She was Kiluo."

I shuddered. "Kiluo is in her tomb. Riao now deals for us with the Unseen." Bracing myself: "But why should this be strange? You never grow old, you Night Folk."

A sound like a breeze through darkness blew from her mouth. Did I hear sorrow? "We do not grow old as fast as you, Ak'hai'i."

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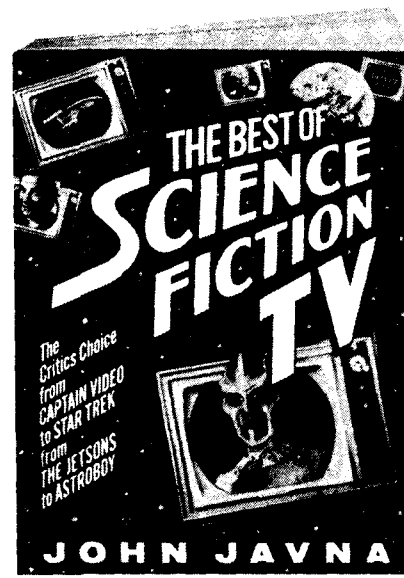
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At that, somehow, the hope within me turned from fire to ice. I had trapped and tricked Sten. I had made him guide me here, because else I would have made the sun burn him alive. Now Nadia said they also must someday die. "Have you no power to save us?" I howled.

They talked together.

"I will go," I said dully. "Forgive my people that I troubled you. They knew naught of it."

Nadia raised her hand. "Wait," she called. I turned back. The blood knocked in my head. "You have dared what none before you ever did, Ak'hai'i," she said low. "We would help you because of that, if we can. I make no promise. And I fear the price to you must be heavy, whether you win or lose. Are you willing?"

"I am, I am," I sang.

A moment she sat quiet. Her teeth gnawed her mouth. "Can we bring ourselves to this?" she wondered.

"I think we must, whatever it costs us," replied Sten, likewise in my language.

She commanded her ehin to go west. "Follow," she said.

He mounted his. I came behind. The hunting beasts loped at my tail.

Of what happened thereafter I can say very little. We lack the words. We lack the eyes and the thoughts. Do you understand? A thing may be so strange that you cannot *see* it. You do not know how to look. It is like a mist where colors go swirling, now bright, now dim, never the same. Sometimes the mist rolls aside somewhere, and for a breath a shape stands forth, but it is like an icicle or a lightning bolt; and what you hear is like voices in a dream that seem to have meaning until you awaken and cannot imagine what the meaning was.

We three had fared a ways when Sten gaped and stretched and mumbled something. Nadia spoke back to him before she explained to me—how kindly they both had become!—"He is weary."

By that time my surprise could only be dull, but she observed it. Her mouth curved as she said with a ghost-wind of breath, "We grow weary and must sleep the same as you. Sten has been traveling on his rounds since sundown."

"Was it a hard journey?" I asked, wondering what dangers he might have encountered.

She barked a tiny bit. "Not until he met you. He was just seeing if all was well with our fields. But it has been a long wakefulness for him." She was quiet a spell. The hoofs of the ehins thudded, the leather of the seats upon them creaked. "In the place where we should be, the days and the nights are but half as long as here."

"Why do you not stop and rest?" I blurted.

"We must be sure to return before dawn."

"Is it true the Night Folk cannot endure daylight?"

Her head moved up and down. "Your sun burns too cruelly bright for us."

Bewilderment silenced me.

I was tired myself when we ended our journey. But what I found there took from me every sense of mortality. I was like the spirit of one unentombed, bodiless awareness in a world no longer mine. This world, though, had never been mine; I had not even a memory of it.

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The stronghold of the Night Folk stands on high ground above the sea. Forest is at its back and trees grow around three sides of it. The fourth looks down into a bay that was then a broken path of light under the sinking moon. Mightily rear those walls, stone and timber, beneath a roof that is also of cloven wood. The windows are filled with clear ice that never melts, and dawn-soft yellow light glows through it. Nearby are the worksteads. Of them I can say naught, except that I saw flames flicker and heard iron ring upon iron, with undergroundish noises as of whirring and tramping. I was brought to the house.

Forth they came to meet us, the tall Night Folk, and more from the woods and the worksteads, carrying lights in their hands that I thought at first, seeing them at a distance, were stars descended upon earth. By this and the shining windows I saw how garb upon the Night Folk was colored, fire-red, sunseeker-orange, springleaf-yellow, gem-green and sea-green, heaven-blue and sea-blue, blood-violet, the white of snow and the black of oracular pools. Their speech caroled and surged about me. I believed some were angry and would have stricken me dead with the iron things they bore, but maybe I was mistaken. Sure it is that the will of Nadia and Sten prevailed; and who had better right to spare my life than Sten? The first brightening was above the Forest when they led me within.

And there—I cannot say what was there. I am not forbidden, but I am not able. No mortal would be. I may speak of soaring rooms and rainbow hues and music that bore me on its tide, but how shall I conjure this up out of the passage grave that is my memory? That I can never share the miracle has set me apart forever.

They gave me a place to be by myself. They brought me food I could eat, and pure water. They heard me out, questioned, listened, talked one with another, went off and left me alone, came back and questioned further. Sometimes they named names I remembered, Wold People, though all whom I had ever heard of or known as a child were dead. Indeed the Night Folk had gone among us.

"Mostly we sought to learn about you, to understand you," Nadia said once. "Certain things that happened were bad. I suppose that is inescapable, when races are altogether unlike. We cherished hopes—but they came to naught, and now we seldom leave the Forest."

Day broke. The dwellers drew into their great house of many rooms. They closed wooden slabs over the windows. When any of them must venture out, he went muffled and shaded, with pieces of black ice masking his eyes.

"This is not our world, you see," Nadia told me.

"Whence came your forebears?" I whispered.

"It was far away, beneath a gentler sun," she said. "They fell from the sky long ago, long ago . . . as you reckon lifetimes. Since then we have made what we could out of what we have."

In my puzzlement I could not ask further.

The day wore on. About noon, I met with one who seemed almost a Watermother, though male. The hair on his head was white. "Did the Charioteers learn their arts from you?" I made bold

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to question him; for I had seen ehins drawing wheels.

"They did not," he avowed. "We knew no more about them than that there are herders on the eastern plains. Nor did we know, until you bore us the tidings, that any have moved this far west."

"They ravage and slay," I said. "In the name of whatever friendship ever was between the Night Folk and the Wold People, help us. Else we perish."

"What would you have us do?"

"You can tell better than I. Give us iron weapons and chariots of our own, and school us in their use?"

"The invaders are too many for you, I fear. That is an enormous country which bred them. Also, would you gladly become what they are?"

"Then go against them yourselves," I urged. "Ride to their camps in the dark, strike them with the lightning that the stories say you can wield, drive them back from us."

"Nor can we do that," he said, gentle and merciless. "They have their own right to life. Drought holds the plains, and will not let go for generations to come."

My anguish lashed at him: "How can you know this?"

His straightness sagged a little. "We do know. We always did. Your heavy sun and your huge moon pull so hard upon this world of yours that its spinning changes swiftly . . . as the stars reckon lifetimes."

Thus he said. The words echo in me like words from a Hallows' Eve dream, never to be understood, never to be forgotten. In my later years, I have thought that maybe he meant the skewing of the heavenly pathways.

I crouched down in that dim room full of gleaming things, tail raised as if for battle, and screamed, "But have *we* no right to live?"

He turned and went from me. His garb billowed with his haste. Did he flee? I sought the room that was mine, lay there with eyes shut, and tried to call Hroai and our children to my spirit. They could not come. I had wandered too far, into a land too other.

The sun trudged west.

Sten entered my refuge, which had become my cage. The times we talked had given him a better command of earthly language. His voice wavered. "We may have discovered what we can do for you," he said.

You may think this is the end of my story. The rest you have heard, since first you could listen, until it is woven into flesh and bone. I say to you, it was not the end. Through the rest of my life grew a slow understanding, for whose fullness I strove last night when I stood on the clifftop and the ghost boat sailed by. Today I would give you what understanding I do have, if I am able, for you may have need of it after I have gone home to my Hroai in our dolmen.

You know how I went in another ghost boat, on the tide that followed the sunken sun, with two of the Night Folk, Nadia and Sten, they were. The wind filled the sails and we bounded over long, murmurous waves, across which the moonlight flowed in rivers. Smells of salt and the deeps filled my tendrils. Great creatures broached and wings skimmed low, but we fared unharmed across the waste, and at dawn we raised the easternmost of these islands.

I went about it during the day, while

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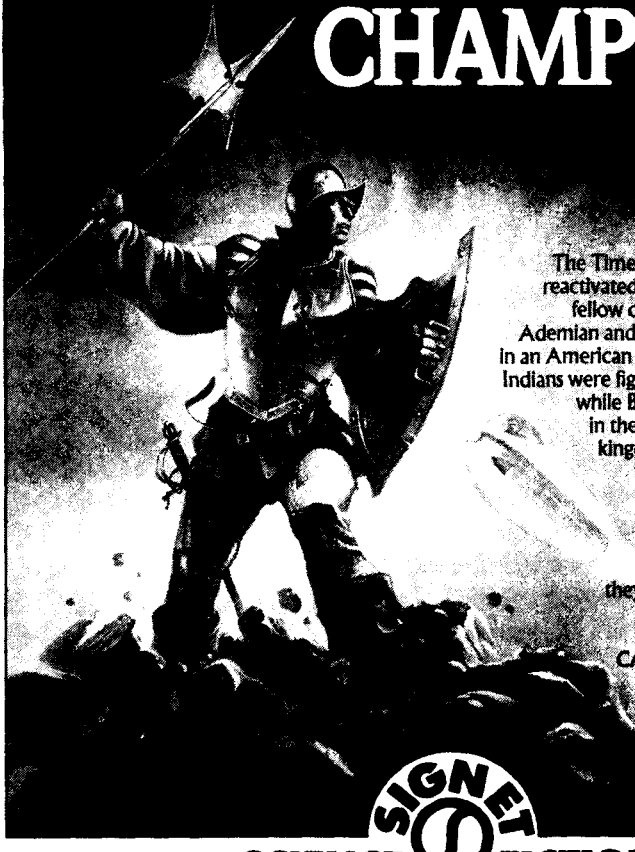

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Sten and Nadia sheltered in a tent on the strand. "It is good country," I told them. "The soil is rich and the springs are fresh."

"We are glad," Nadia answered. "We knew simply that it was here."

"But it is lonely," I said.

"That is well," Sten replied. "None will dispute your settlement. None will pursue you."

He spoke truth. I could not bring myself to say it was barely half a truth. Where were the tombs? How could we remain one with our ancestors if we forsook Motherland?

At darkfall we three set homeward. Winds were ill-humored and morning found us still at sea. The Night Folk stretched the larger sail across the hull and huddled. For me that might have been an empty day, rocking on an endless gleam of waters. Instead it became a time of magic; for we talked freely together, we three. I came to learn a little, little about the Night Folk. Sten said they knew how to make a thing that would drive a boat without sails or paddles, but had never found time to build it, they being few in a foreign world—

Well, this is not what I mean by understanding. It is merely words. Water and words may pass between the worlds without carrying death; water, however, quenches, while words raise a thirst that can never be slaked.

We landed early in the dark and found that the Night Folk in their stronghold had the canoe ready. Often have I had to make clear why this was what they made for me, instead of a boat like their own. I will tell you again. To make a ghost boat and to handle it are craft, wizardry, beyond us people. We might have learned how, but it would have taken more time than we had. For us the Night Folk devised the simple dugout with paddles and square mat sail that you know. In the next few days in the house and darks in the open, they taught me well how to make more and how to bring them over the sea to the islands.

And then they sent me back. I returned with my hands empty but my spirit full. I prophesied and I taught—the help of Watermother Riao and the strength of Hroai upbore me—and those months were bitter, for who would willingly leave Motherland? We did at last, we Wold People, thorp by thorp, with our homes aflame behind us; and here we are, and *this* is your home and you are happy in it.

But our ancestors are all alone.

That, and a memory of dawn stealing over the downs, are the price that we, your mothers and fathers, must pay. Will you and your children and your children's children repay us, care for our tombs and call on our dreams? Or will there be only the Night Folk whispering to us?

And I, I gave more. Half my soul it was, as the old songs warned. I have been in the house of wonder; it will always haunt me. None else will ever know what I have known, and so I too am forever lonely. Yet I remember the look upon Hroai when I brought hope to her.

And also the Night Folk have paid. I have not understood what it was they must give up to the Unseen because of what they did. But as we said farewell, Nadia caught me in her arms. "When we were beginning to know you!" she cried softly, and laid her mouth upon mine. Water welled from her eyes. It tasted salt. ■

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Paul S. Wesson

COSMOLOGY WITHOUT THE BIG BANG

Cosmology is changing. Chronic problems with the standard theory of the universe have led to a surge of new ideas, perhaps the most intriguing of which is that things need not have started in a big bang after all. In this article, we shall take a look at why the old wisdom is crumbling and what might replace it.

The standard (big bang) theory of the universe is based on certain assumptions that are derived from observations. Let us start by reviewing these assumptions.

First, the universe is expanding. This is inferred from the redshifts in the spectra of remote galaxies, which interpreted as Doppler shifts indicate recession from us. There have been other interpretations of the redshift, such as the "tired light" hypothesis, but they do not work as well as expansion, so let us stick with the latter explanation.

Second, the universe is uniform. This is an approximation, based on maps of the distribution of galaxies in space. Many galaxies are actually in clumps, such as groups, clusters and superclusters. The existence of these clumps implies a certain degree of nonuniformity. But the largest clumps known for sure, the superclusters, appear to be randomly distributed, so over larger distances the universe is believed to be uniform. (It should also be noted that a given clump of galaxies does not increase in size as the universe expands, because it is bound by gravitational forces. But the overall expansion is still a fact because the clumps recede from each other.) The uniformity assumption is constantly under review by observational cosmologists, but in this article we shall presume its validity.

Third, the pressure of the universe can be taken to be small. This certainly appears to be true now, since there is no known medium between the galaxies that pushes them apart: they are like dust particles, dispersing through empty space. It should be appreciated, though, that there is no completely reliable way to decide what the pressure was long

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ago. In the standard theory of cosmology, it is often assumed that the universe was extremely hot in its early stages (see the next paragraph), and this implies that the pressure was finite then. However, the pressure was still only a fraction of the energy density of matter, so this does not alter things much. We shall come back to the subject of the pressure later, but for the present discussion of the standard theory let us assume it can be taken to be small.

Fourth, there was a period in the early universe when it was extremely hot. At present, there is a field of electromagnetic radiation filling space that has a black-body spectrum with an effective temperature of only 3K (i.e., 3 degrees above absolute zero). The best explanation found to date for this 3K background is that it is the cooled-down radiation from a period when the universe was very hot and dense. There have been numerous other attempts to account for this radiation, but most of them cannot explain why its temperature is very nearly the same in all directions. Thus for want of a better explanation most cosmologists assume it is the remnant of a primeval fireball.

The preceding four assumptions produce the standard account of cosmology when plugged into Einstein's theory of general relativity. The latter is a theory of gravity, which is assumed to be the dominant force in cosmology. We have to use the theory of Einstein, rather than the simpler one of Newton, because the latter is not accurate enough when applied to the universe in the large. Of the four assumptions discussed above, it is the first three that are actually responsible for the major features of the resulting cosmological theory. In particular, it is these assumptions plus the equations of general relativity that are responsible for the fact that the standard theory starts with an explosive kind of event at time zero when the density is infinitely large. It is this explosive singularity that gives its name to what has become the best-known account of the universe: the big bang theory. By comparison, the fourth assumption only modifies the early stages of the account, though in recognition of its importance some cosmologists like to talk of the hot big bang theory. The phrase "standard theory" is also in widespread use, and in this article this phrase is used to mean the big bang theory in which all four of the assumptions discussed above hold as specified. Depending on the precise input data for such things as the present density of the universe (which is highly uncertain but is believed to be of order 10^{-30} gm/cm^3), there are actually several slightly different versions of the theory, which are commonly referred to as standard models. The expansion histories for the main standard models are illustrated in Fig. 1.

The standard theory starts with a big bang of infinite density, but as the expansion proceeds the density decreases, and at some late stage the theory ought to agree with the real universe. Unfortunately it does not. There are many problems, most of which are chronic, but three main ones can be mentioned briefly. The *timescale problem* is that the time elapsed since the big bang according to dynamical properties of the theory is only about half the age of the

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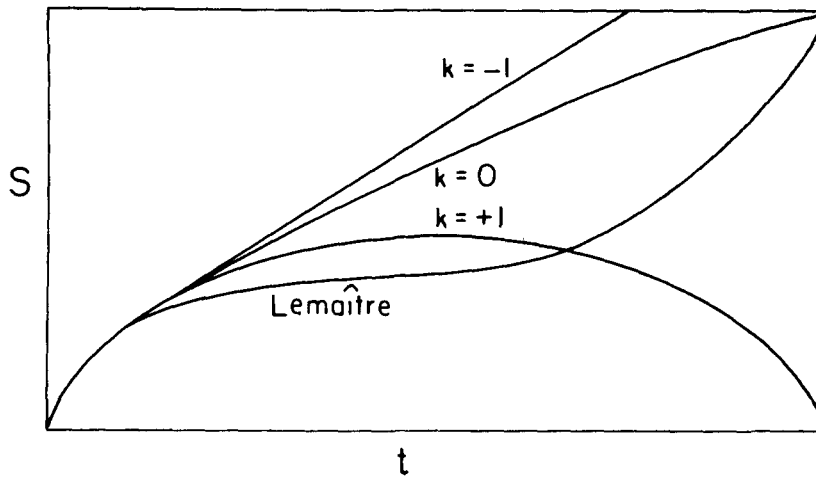

Figure 1: The behavior of the scale factor S with time t in standard models of the universe. The scale factor is proportional to the separation of any two galaxies that take part in the expansion of the universe (not ones that are gravitationally bound to each other or are members of the same cluster). This diagram is sometimes given with the vertical axis labeled as a radius, but this is misleading because it suggests a boundary and there is no such thing in these models. There are three basic types of behavior, depending on the value of a constant k that appears in the theory of general relativity. For $k = +1$, the model expands to a maximum and then collapses. For $k = 0$, the model expands, but slows and becomes static for very large times. For $k = -1$, the model expands throughout its history. Also shown is another type of behavior named after its discoverer Lemaître. This model has $k = +1$, but is modified by the introduction of a positive cosmological constant (this is taken to be zero in the other curves shown). This constant is equivalent to a repulsive force that counteracts gravity. For this case, the model expands, becomes nearly static, and then expands again. All of these models start in a big bang and have infinite density at time zero. And all have serious problems in comparison with observation.

oldest stars seen in galaxies (16 billion years approximately), which is clearly a contradiction. The *galaxy-formation problem* is that according to theory there is no natural way to account for the formation of galaxies with the masses observed (see Fig. 2). Both these problems affect nearly all of the standard models, though they can be avoided by the Lemaître one, which has a period of slow expansion early on. But the Lemaître model has other drawbacks, such as unacceptable present values for the acceleration (rate of change of the expansion) and the intensity of background light. There is also a third problem that affects all those standard models that have a primeval fireball stage. The *horizon problem* is that different parts of the universe early on should according to theory have been out of contact with each other and beyond each other's event horizons, so there should be no reason to expect the temperature of the fireball radiation to be the same in all directions—yet as noted above the observed 3K background does have nearly the same temperature in all directions. We see therefore that there are at least three major problems with the standard theory. To be fair, it should be mentioned that it does have some positive

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aspects. Most notably, the amount of helium synthesized by nuclear reactions during the fireball can be calculated from the theory, and is found to agree with observation. However, many cosmologists feel that the shortcomings of the standard theory outweigh its successes.

There is also a more fundamental problem, to do with the big bang singularity itself. For while it may be possible to talk glibly about this event, it is as well to remind ourselves that by comparison to the rest of physics it is unique and therefore suspect. The existence of a singularity means basically that the mathematics of the theory screws up due to the occurrence of infinities at time zero. Now in other areas of physics where something like this happens, we simply realize that the mathematics is no longer a faithful representation of reality. But in the standard theory of cosmology it has hitherto been common to accept the big bang singularity as in some sense real, a birth

Figure 2: The well-studied galaxy M51. (Also known as NGC 5194/5195, it is a spiral of type Sc with a companion irregular galaxy.) There is good observational data on numerous galaxies like this, but theoretical accounts of galaxy formation based on the standard cosmological models do not work. One problem is that most models expand too fast early on for small perturbations in the matter density to be able to grow gravitationally and form objects like the observed galaxies. This problem can to a degree be avoided by the Lemaître model, since its nearly static period may give galaxies time to form. However, both this and the other standard models suffer from a more fundamental though related problem. Because they start in a big-bang singularity, the origin of matter cannot be analyzed. In other words, the matter content is given by fiat rather than being explained by physics. This is considered objectionable by many cosmologists, and models that do not start in a big bang are therefore the subject of current attention.

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event for everything. This is a suspect attitude because it makes mathematics a master rather than a servant. However, this attitude has not always been present. Originally, the big bang singularity was viewed as objectionable, and attempts were made to avoid it. These mostly foundered, though; and subsequently theorems were proved that showed that an initial singularity was inevitable, given certain conditions on the density and pressure which (until recently) seemed plausible. In this way did people become inured to the idea of the big bang singularity. But of course, it still had all its objectionable characteristics, and in recent years renewed attempts have been made to remove these. One particular aspect of the singularity that is objectionable is that it does not allow the origin of matter to be analyzed at all: matter is given by fiat rather than being explained by processes of physics. Would it not be nice if we could get rid of the big bang singularity and explain the origin of matter at the same time?

This possibility is one of the radical ideas that are changing cosmology, and is the subject of current attention from those who study general relativity. Actually, however, it was already suggested several years ago by those who study particle physics and quantum field theory (which should not be confused with the still speculative quantum gravity theory). They pointed out that according to their theories, particles could be created from the vacuum under certain conditions. The question as regards cosmology therefore is how we can mimic this process in general relativity. The answer is that we need to consider a pressure that is *negative*. This is not really as weird as it sounds. A positive pressure tries to push things apart (e.g., this happens to the particles in a laboratory gas). So a negative pressure is to be interpreted as something that tries to pull things together (e.g., this can happen to particles that are acted upon by certain fields). It turns out that if we take a pressure that is negative and whose magnitude is *large*, then matter is produced: the density rises instead of falling, even though the cosmological model may be expanding. To illustrate just what happens, a computer can be used to find a solution of Einstein's equations under the appropriate conditions, with the result shown in Fig. 3. As can be seen there, the big bang is replaced by a "blip." Such models actually have further implications, for it is natural to assume that the blip is triggered by some kind of quantum event that occurs in the vacuum. So we arrive at a sort of two-stage model for the universe: empty up to a certain time, when a quantum perturbation occurs, and matter-filled thereafter. Models of this type are very different from the standard ones in the early stages (note that we have violated the third assumption discussed above). But they are similar in the late stages, and are viable cosmologies.

The idea just outlined may remind some people of the late lamented steady state theory, which featured continuous creation of matter. In fact the steady state theory can be obtained by choosing the pressure to be exactly equal in value but opposite in sign to the density, *for all times*. In this case matter is produced at just the right rate to offset the dilution

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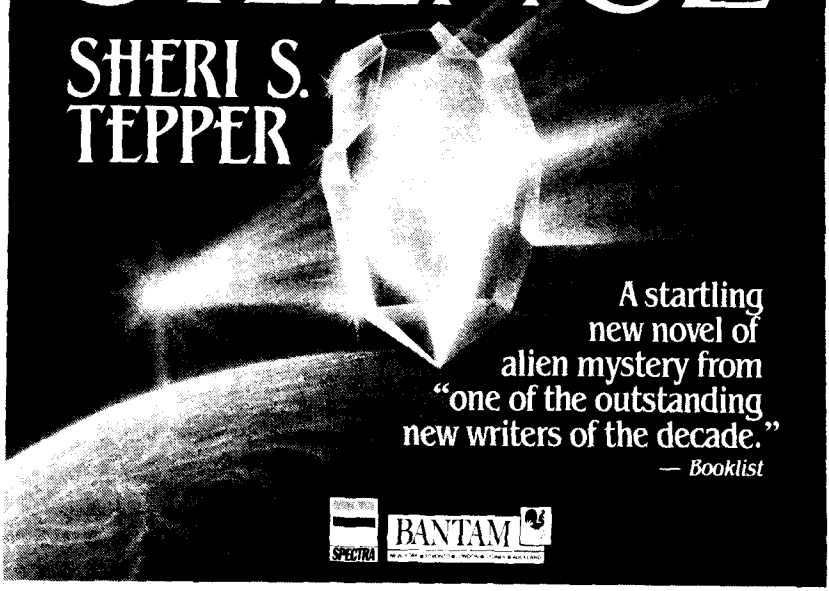

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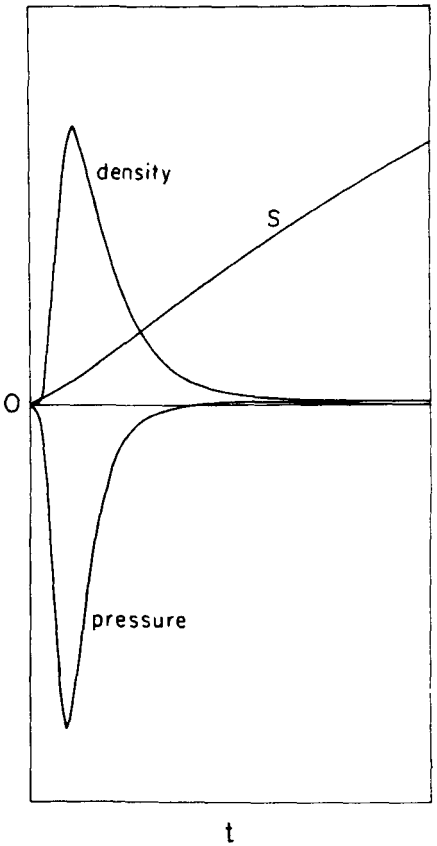

Figure 3:
The behavior of the scale factor S and the density and pressure of matter with time t in a uniform model of the universe that does not start in a big-bang singularity. The density and pressure both start at zero at time zero, but the pressure goes negative (meaning there is a tension between the particles) and the density rises to a maximum and then declines. In this model, the big bang is replaced by a "blip" in which matter is produced from nothing, a possibility allowed by the equations of general relativity. The blip in this particular model produces matter that is hot, so there is no difficulty in accounting for the origin of the 3K radiation that presently pervades the universe. This model may also be considered in an extended version, where it is preceded by a lengthy stage where there is no matter. Thus it is possible to imagine that the universe existed empty for a time, experienced a perturbation (perhaps quantum in nature), and then produced matter and evolved into something more familiar. Such two-stage models have been studied by W. Bonnor and the author, and are viable if somewhat unusual cosmologies.

caused by the expansion and keep the density constant: a steady state. But this theory lost popularity largely because it had no fireball stage and could not account for the origin of the 3K background. This shortcoming is avoided by the new models, because in them the pressure causes a surge of matter creation early on and conditions that are very hot, before the expansion takes over to reduce the density and cool things down. The new models, and in particular that shown in Fig. 3, can also avoid the horizon problem discussed above. This makes them attractive, but it is still too soon to know how widely they will be accepted.

Another new idea for avoiding the horizon problem is that of inflation. In the inflationary model, a region that is initially so small that it does not have an horizon expands rapidly or inflates, and becomes the entire visible universe. Since all parts of the initial small region are in contact, the temperature of the fireball radiation at later times should be nearly the same in all directions, as observed. This idea, due to A. Guth, has been very popular in recent years, but interest in it is now waning because it runs into other problems. However, in the same article where he suggested inflation, Guth also introduced another idea that may have more lasting interest, that of a phase change.

Everybody is familiar with certain kinds of phase change: water turning to steam is one. The kind that might conceivably have happened in the early

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universe is more complex in origin but has some of the same characteristics. At very high temperatures, it is believed that elementary particles interact according to laws based on certain symmetry principles. If the temperature declines, the relevant symmetry alters, and the fluid comprised of the particles undergoes a phase change. This process is somewhat hypothetical insofar as it is based on theory and has never been observed. But it does raise the exciting possibility that the very early universe (perhaps just after the big bang if there really was one) experienced one or more phase changes as it expanded and cooled. During such a phase change, bubbles of the new phase might have appeared in the old phase, like steam bubbles in boiling water. The nature and fate of bubbles and other structures that could be produced by a phase change are of interest, because they might in some way nucleate density perturbations that eventually could grow into galaxies. Although other new ideas make varying progress towards a resolution of the galaxy-formation problem discussed above, that of a phase change is perhaps the most promising in this regard.

With respect to resolving the problems that face the standard theory, it should be appreciated that none of the new ideas are completely satisfactory. The time-scale problem is especially persistent. It should also be mentioned that some cosmologists feel that it is not the input assumptions that are at the root of our cosmological troubles, but the theory of gravity that is used. They doubt that general relativity can be extrapolated from the scale of the solar system (where it has traditionally been tested) to the enormous distances and times dealt with in cosmology. Alternative theories of gravity that have been proposed have different implications. But one that may be mentioned here because of its relevance is an extension of Einstein's theory wherein the rest masses of all particles may increase slowly with time, starting at zero at time zero, so there is no initial singularity. New ideas about both the assumptions and the underlying theory were discussed at a recent conference (held at the Vatican observatory in 1985) which was attended by about twenty professional cosmologists. Many of them expressed skepticism about the standard big bang account of the universe, but there was no consensus on what might replace it.

The fact is that cosmology is in a state of change. We know that the old views are probably wrong, and we have several new ideas that are promising, but we have yet to construct a really coherent new account of the universe. ■

About the Author

Paul S. Wesson received his Ph.D. from the University of Cambridge in the U.K. and is now Professor of Physics at the University of Waterloo in Ontario, Canada. He has published two books and numerous articles on cosmology, including one in *Astronomy and Astrophysics* (V. 151, p. 276, 1985) that shows how the big bang can be avoided and references other papers on this topic.

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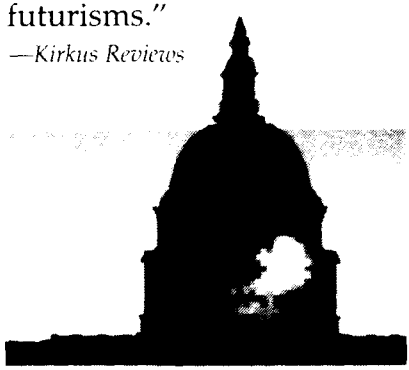

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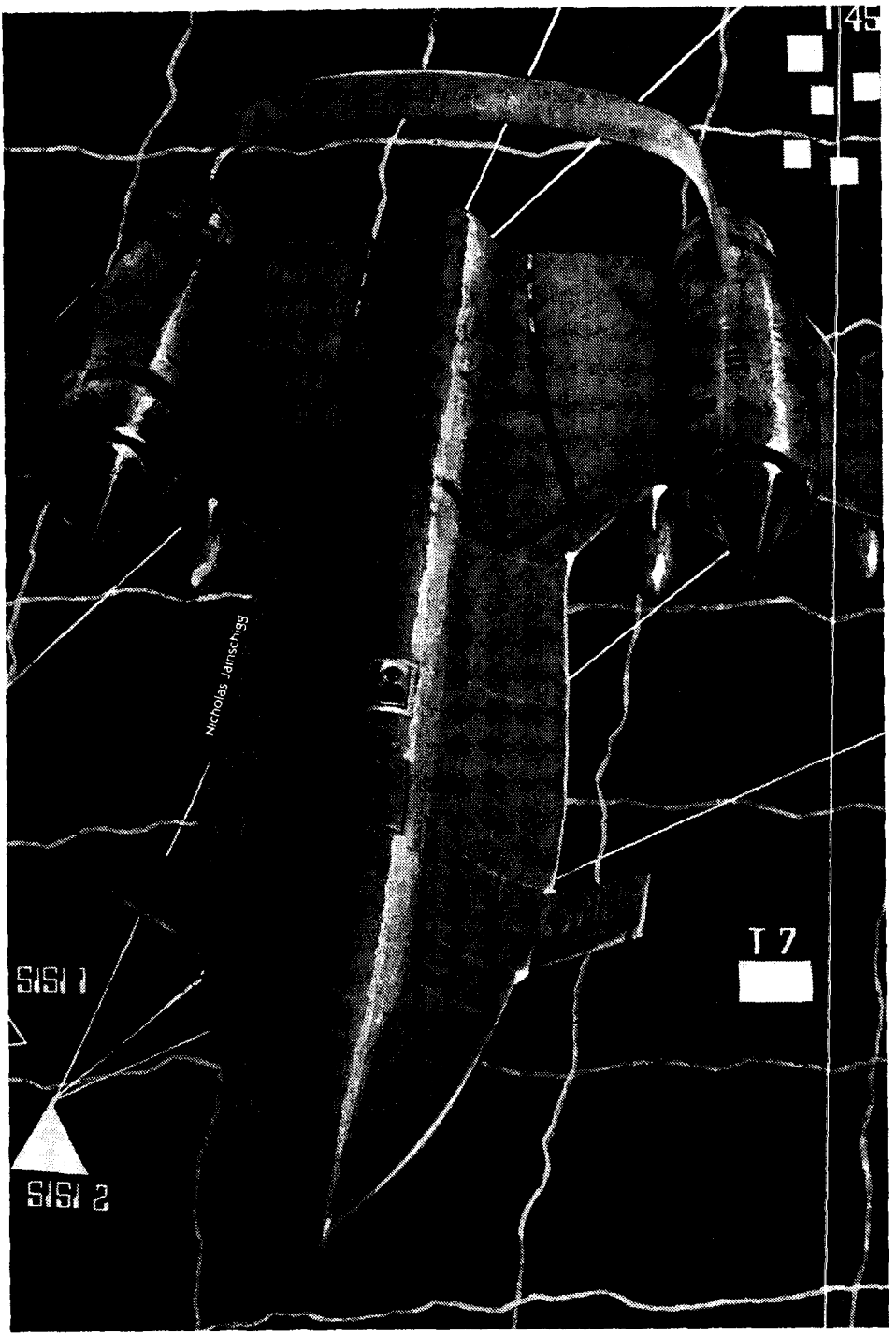

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0400 Zulu; Akira plateau, Ngai Free Republic.

The red "Incoming–encrypted" light blinked twice. Captain Bade Okibo flipped a switch on his console to decrypt and record the conversation. "Ready."

"Sector Anga status report. All quiet along the border, situation nominal."

"Acknowledged. Any movements on the radar?"

"Herd of gazelles passed by 'bout an hour ago."

"Roger." Okibo considered reporting that to the Ministry of Conservation. Gazelles were becoming increasingly rare in Ngai, and MiniCon might be interested. No, he decided; his job was to guard the border, not play shepherd to the wildlife. "Okay, Terry, keep up the good work, and I'll talk to you when your shift is over. Keep alert out there, okay?"

"Will do, sir. Sector Anga out."

Okibo was perfectly aware that his border station would not be attacked. He knew this for an excellent reason: although Gorotoland claimed sovereignty over the two border provinces, and had claimed so for half a century, smaller, less populous Ngai had a modern, well trained and organized army and an air force second to none in central Africa. Any incursion into the disputed territory would result in decisive retaliation, and Gorotoland would not last long. So when the intrusion alarms went off, signaling a full-scale attack on the border, Okibo expected it must be an unannounced test of the division's combat readiness.

Of course, he realized otherwise when he heard the distinctive whine of incoming artillery, but by then it was too late.

5:13 A.M.; Owl-Eye Corporate Headquarters, Amsterdam.

Sally Martel warmed her hands over her cup of coffee and tried not to yawn too conspicuously. She'd been quite sound asleep when urgent noises from her beeper woke her up—far too early!—for an emergency meeting with company hotshots. Right now what she needed was a long shower and another two hours of sleep. What she was going to get was a chance to stand up in front of a group of executives and try to act confident, competent, and coherent. Her hair, which she wore long in the American style, was a mess. It always was when she didn't have time to battle it into shape in the morning. There was something to be said for the short European style.

She would have to speak as soon as Danny Bourque finished off the background briefing. She took a big gulp from her coffee and tuned in to what he was saying. Danny was tall and slender, with a bushy red mustache and a reputation for being sharp, but easy to work with. She was glad to find he was on the team.

". . . borders drawn in the nineteenth century by ruling families in Europe, who paid no attention to ethnic or tribal boundaries. The two provinces in question are inhabited primarily by the Abagai tribe, who are a minority in Ngai, but form close to a majority of the population of Gorotoland. This ethnic division has been a constant source of friction between the two countries, and forms the historical basis of Goro-

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toland's claim to the territory. The situation has been tense, but stable, since Gorotoland's independence from Britain fifty years ago. In the last few decades though, the Akira plateau has been found to contain high-grade deposits of bastnasite, the major source ore for lanthanum, which is a critical material for high-temperature superconductors.

"Owl-Eye is contracted to provide Ngai with satellite reconnaissance information and unbiased simulations of the outcome of possible attacks, and we are contracted for additional computer and arbitration service in the event of war. It looks like this small contract could turn out to be a big one, gentlemen. And, of course, failure or misinformation on our part could leave us liable for damages of up to ten billion Euro-marks.

"That about covers it for the political and economic side of things. For the military situation, better listen to Sally."

"Thank you. Next, the senior reconnaissance and tactics analysist for the Ngai contract, Sally Martel."

Sally stood up. "Thanks for laying the background, Dan. I regret to say that the attack on our client came as a complete surprise to us in reconnaissance. As you can see from the military assets of each—" she flipped a switch, and the vuescreen showed graphs comparing the two military forces "—the countries are roughly matched in army strength, but Ngai has a decisive advantage in air power. We have, of course, kept up to date on computer sims on possible confrontations. This one," she flipped to the next graph "was done last week, and shows several alternate scenarios in which Gorotoland starts by making a surprise attack across the border. As you can see," she flipped rapidly through several more "in all the cases, although Gorotoland starts out with an advantage due to surprise, within twenty-four to forty-eight hours Ngai has virtually eliminated the offensive."

One of the corporation vice-presidents, a humorless man with a white mustache and a suit one size too small for him, spoke. "Then what is going on? The maxim of our business is that nobody ever starts a war unless they think they can win, and nobody ever fights a war when they know they will lose. Why did Gorotoland attack?"

Sally took a deep breath. "I don't know. At this point, all I can do is speculate. Clearly Gorotoland must have something up their sleeve if they think that, even with the advantage of the surprise attack, they can win this one."

"Obviously. And you have no idea of what this might be?"

She shook her head slowly. "No."

"Let me draw your attention to the following." A satellite photo came on the screen, showing the browns and greens of high desert flecked with silvery rectangles. Sally recognized it as a close-up recon photo of the border desert, one she'd already spent several days analyzing. "In the last two months, several of these constructs have appeared on the Gorotoland side of border. Can you tell us what they are?"

"Yes. These are large tents, constructed from aluminized mylar. Eighteen such tents have recently been erected in Gorotoland."

"What are they for?"

"We don't know for sure." She shrugged. "Similar tents are used by

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some nomadic tribes as temporary shelter for animals. We speculate that the Gorotos may intend to expand agricultural activity into that area."

He leaned back and stroked his mustache. "Could they be concealing something?"

"That was the first thing we considered when they began to be erected," she said, "and we've been keeping them under surveillance. We have observed no loading of military supplies into the tents. IR and doppler lidar observations tell us that the tents are empty."

"Miss Martel, we are meeting with Yokino Corporation—Gorotoland's rent-a-spy company—in an hour. At that point it will behoove us to act on complete information, not speculation. I trust you will have full and complete information ready for us?"

"Yes, sir." Damn him.

0530 Zulu; Akira plateau, Ngai Free Republic.

Sunrise. Sergeant Terry Gautreaux looked out across the plain to what remained of the Ngai border station. He is Abagai—most of the border Abagai took French names way back when Ngai was part of French East Africa—and his men, all fellow tribesmen, are fanatically loyal to him. And he is loyal to Ngai.

A flicker of movement on the horizon caught his eye, a flight of X-fliers skimming in to pick up wounded for evacuation. He diverted his attention back to the sissy-gun battery. As far as he could see with contrast-enhancing binoculars, only two soldiers guarded it. The guns were useless to the invaders, since the battery was keyed to individual operators. Undoubtedly they'd removed or destroyed the operator's helmet, figuring that would be enough to put it out of commission.

Perhaps they didn't know he had a spare.

He motioned his men to stay back, maintaining radio silence. Radio was encrypted, but he didn't yet want to let the enemy even *consider* the possibility they had overlooked a patrol. He sprayed the back of his jacket with liquid nitrogen to break up his IR silhouette from prying satellite eyes, and began to crawl forward, taking every possible advantage of the rugged terrain.

Twenty minutes later he was in a position where he could clearly see the sissy-guns. Yes, only two guards. Time to break radio silence. "Go, Blue Red Red. Go, Blue Red Blue. Get 'em, brothers!"

Behind him he could hear the high-pitched singing of hypervelocity rifles opening fire as his men started their assault. While they diverted attention, he began to sneak up on the soldiers guarding the battery. If he could get in and get the sissy-gun firing, he would be able to do a hell of a lot of damage before they could call in an artillery strike to put him out of action. He had his garrote over the neck of the first of the guards when he heard the sound of more X-fliers coming over the horizon.

"Hold your fire. Do not move. Hold your fire." Amplified voices echoed across the plain. The fliers were painted in bright red and blue stripes: arbitration colors. "Hold your fire. Further hostilities may be subject to criminal prosecution. This area is declared a cease-fire

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zone by agreement of the Gorotoland-Ngai arbitration committee."

Damn. Another minute and he would have had something to show them. He let go of the garrote, and the soldier he had attacked dropped to his knees, gasping. Looking into his frightened eyes, Terry saw that he was Abagai. "You were dead, brother," Terry Gautreaux said to him softly, in the tribal tongue. "I own your life. Remember that."

6 A.M.; Owl-Eye Corporate Headquarters, Amsterdam.

The working group consisted of a tweed-suiter representing management, plus Sally, Dan, and a fat computer jock who Sally didn't recognize. Like her, he was an expatriate American. That wasn't unusual; just about everyone who had any kind of technical skill had left the U.S. after the constitutional convention. A lot of them ended up in Holland.

"Their attack followed right along one of the scenarios for an optimally effective surprise assault." The cojock grinned, as if he considered it a rather exciting game. "Here's something interesting: our simulation predicted an average of one tactical blunder by the attacking force due to inexperience in the field. So, guess what? Turns out they miss a unit out on a perimeter patrol that happened to fall between the coverage of two satellites. Patrol leader is right on the ball; figures the situation, sets up a diversion while he goes in commando-style to liberate a SISI gun battery right under their noses. A maximally sweet maneuver. Would've made it, too, 'cept the cease-fire order happened to get him just as he made his move."

Sally frowned. "Damn. Would it have made a difference?"

"To the war? Nah. Guy woulda taken out 'bout half a platoon and a buncha material before they blew him away, but that makes little dif to the overall. Does this for us, though: if their arbitration team claims our effectiveness figures are too low, we use this as evidence.

"One other thing. I've been analyzing their dep strategy. There's something screwball about it, and we finally got it pegged. Ngai's got clear air superiority, but the Grotes dep as if they expected clean sky. Weird."

"But what's the final conclusion?" asked the management rep.

"Long term? Same as ever. Ngai is gonna cream 'em. Not very exciting. Doesn't matter what they try; they lose big time. Hardly worth the sim."

"Now that the element of surprise is gone," the corporation man said, "Gorotoland is asking to negotiate. As expected. Miss Martel? What's our status? What about the big tents?"

"We've looked at them, IR, UV, radar, lidar, the works. They're empty. We've got it under continuous surveillance from geosynch, and in another five minutes we'll get another close-in from the low-orbit satellite."

"But what are they?"

"Big sheets of shiny mylar. Nothing more."

"Can we see the satellite images?"

"Sure." She commanded the display. "This is long view, beamed in real time from synchronous orbit to our receiver. Those squares are the tents."

"What's the movement there?"

"I don't know. Looks like they're pulling down the tents." The tents came

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off. On the sand beneath could be clearly distinguished rows of long, lean metallic fuselages with swept forward wings and stubby canards.

"What in the world are those?"

"Rapiers," said Sally. "Jesus Christ, those are Rapiers. Dozens of them."

"Rapiers?"

"Yeah. Remotely piloted mach-three fighter-bombers."

"Hot damn," said the cojock. He was staring raptly at the screen. "This does make things interesting. Just wait until I run this variant."

"How the hell could we have missed something like this?"

"No shit. Wait a minute, the low orbit eye is coming into view. There! God, I can see 'em clearly now. Rapiers! And a couple of batteries of antiaircraft SISI guns to defend them. Jesus, where did they buy that many Rapiers? Even Ngai only has a dozen or so. I thought Gorotoland was too poor to buy stuff that modern."

"The question isn't where they got them. The question is, what are we going to do next?"

0600 Zulu; Oni Air Base, Ngai Free Republic.

General Tommy Gonai stood in a bubble of silence, watching his planes—loaded down with fuel tanks, missiles, and bombs—stagger into the sky. Whenever he moved slightly, a semiquaver of jet noise squirmed past the bubble before the computer found his new position and adjusted the cancellation projectors to compensate. Although the regs required him to be in the operations bunker, he always did like watching his planes fly, ever since they stopped allowing him to fly them himself. And Oni Air Base was about as safe as anywhere.

At last the final plane of the first wing was in the air. It joined its wingmates circling the airbase, and the entire flock pointed northeast and vanished toward the horizon. Their mission was the Gorotoland Command, while third and fourth wing provide air cover for the main assault by the Ngai army. He rubbed his eyes. The mission was like dynamiting goldfish in a wading pool; the enemy had no air power worthy of the name. He expected little more than token resistance.

Ahmed Sago, his number one subordinate, came up behind him and watched the planes disappear. "Kill 'em, tigers." He smiled, his teeth white in the morning sunlight. "We're gonna crush them."

"True." The rush of elation from watching the planes drained away without warning, and suddenly Gonai felt tired. "There is no way they can match our airpower. But it is not good to be happy about it."

"Why not? They started it, they're going to pay for it. I just hope they don't surrender before all the boys get a chance at combat. A taste of blood will do them a lot of good."

Gonai sighed. "War is pointless now; surely even the enemy knows that. They were fools to start a war. I hope they come to their senses in time to avoid more needless bloodshed."

As if in answer to his prayer, an X-flier came in from the horizon. The defensive SISI guns swiveled smoothly around to track it, but it made no attempt at evasive maneuvers, and the guns did

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not fire. There was no need to; it bore the distinctive red and blue stripes of negotiation. Tommy heard the orders in the bone-condition radio implanted behind his ear at the same time he heard the amplified voice from the X-flier. "Hostilities have been suspended for negotiation. All hostilities have been suspended . . ."

He turned to Ahmed, who stared at the flier in open-mouthed shock. Hadn't he realized that old style warfare was obsolete, that after the initial surprise was gone there was no point in actually fighting the battles, wasting real lives when the computers could tell who would win? Gonai smiled. "Get on the line to the pilots, Ahmed. Tell them to turn back. There will be no more blood spilled. Not this morning."

8 A.M.; Owl-Eye Corporate Headquarters, Amsterdam

The meeting with corporation bigshots had seemed like an introduction to the private interrogation chambers of hell. They demanded to know how she could have missed any signs of fighters under the sheets, and she had no answer. Now, at last, they had broken back into working groups. The cojock immediately went off into simulation heaven, while the tweed-suited executive continued to yap at her with questions.

"No question about it, seventy RPV fighter-bombers." Sally was getting a bit tired of answering the same questions over and over. "I don't know how they hid them. There was nothing under those sheets yesterday. Nothing. I bought pictures from the RCA and Spot satellites, even managed to steal an analysis from the American radar satellite, and there was nothing there but mylar sheets over bare sand."

"Could you explain again how you are so sure nothing was there, when you admit you can't see under the tents?"

"Lots of ways. For one, infrared analysis. Something under the tents would absorb heat during the day, and radiate it at night. We can see that disturbance in the heat flow. Visual surveillance, for another. Fighters would have to be brought in sometime, and we'd see it. Even if they managed to sneak them in between the high res satellite passes, and hide them from the low-res geosynch satellites, they still couldn't hide the trails from the radar satellites."

"That's all inference," said Dan.

"True, it's all inference, but when we put enough pieces together, we know what must be there. Or not there."

"Except," the executive commented sarcastically, "Obviously you don't."

"Maybe we've been tricked?" asked Dan hopefully. "Could they be wooden mock-ups or something?"

"Uh-uh." Sally shook her head. "You could pull that kind of trick back in the nineteen-forties, before long range surveillance technology. But today, forget it. The mock-ups would have to be so sophisticated you might as well just get the real things."

"Could they be holograms?"

"Negative. The technology doesn't exist. We've scanned these babies across the spectrum, IR through UV, not to mention radar and lidar. No way could you make a hologram stand up to that sort of probing."

"Then how about this: the mylar tents

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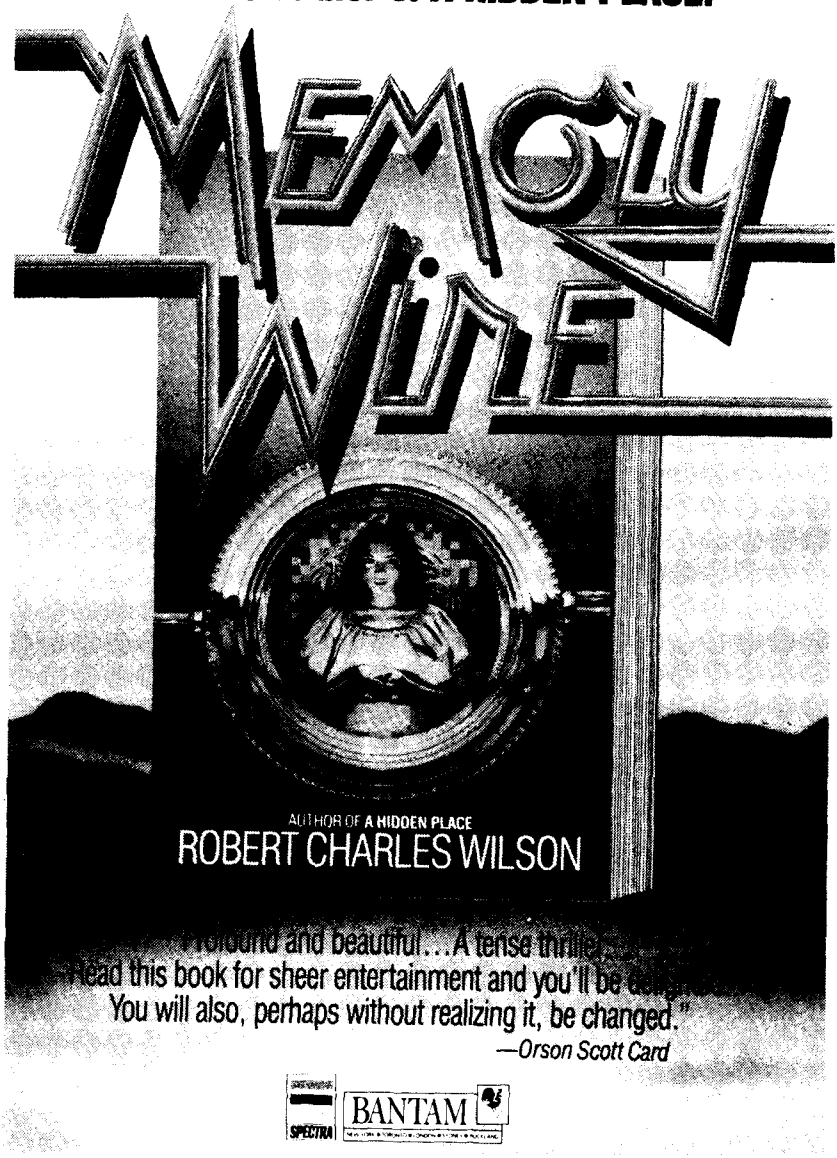
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were holograms, to hide the work on the planes?''

''Maybe.'' Sally was dubious. ''It's easy—well, easier—to make a holo of a plain sheet. But still, over a full range of spectral probes? Tough. Real tough.''

''So what's the conclusion?'' interjected the exec. ''They can't be there, and they can't not be there?''

''Wait, there's something going on.'' Dan pointed to the vuescreens. Tiny human figures scurried around, shoving large tent poles into the ground. ''Will you look at that? They're putting the sheets back up again.''

''Jesus, can you figure it? They give us just enough of a look to verify that the planes are actually there, then they hide 'em again. What the hell for? We know they're there, now.''

''Ah, but do we, now?'' said Dan. ''Me, I'm beginning to wonder whether we know anything at all.''

Interlude: Excerpts from Owl-Eye Corporation publicity brochure.

''For centuries philosophers argued that war was due to 'man's warlike nature,'—and thus fundamentally irrational. Naturally, as long as people believed this, it was impossible to prevent war.

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11 A.M.; Owl-Eye Corporate Headquarters.

''Your hologram hypothesis is definitely out.'' Sally dropped a stack of papers on her desk with a loud thump. ''We've analyzed the recon data about twenty ways, and the hologram signature just isn't there.''

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"Okay." Dan didn't argue. "How do we know that the satellites haven't been tampered with?"

"That's ridiculous, Dan, and you know it. Five separate satellites scanned the spot before they put the sheets back up: two we have a standard time lease on, two we special-ordered, and one American military satellite. They tampered with one satellite, okay. You'd have a hard time convincing me two had been tampered with. But five? No way."

"Okay," he said, "next question: how do we get the data from the satellites?"

"Satellite beams a bitmap down to the ground station. Are you suggesting that the ground stations may be giving out false info?"

"It's a thought."

"Hmmm. One or two people in the right places could perhaps make a switch, substitute a fake bitstream. Pretty unlikely, I think. But possible, yes."

"How could we find out?"

"Hmmm. Damn, that's tough. If they're smart, they'd doctor the bitstream in realtime. Their computer would have a simulation of the RPVs already, and as the real data comes in, erase the sand and put in simulated RPVs; the computer compensating for sun angle, camera angle, and all that. Unless they really screwed up, the doctored data would be indistinguishable from real RPVs."

"How big a computer would it take to do that?"

"About that big." Sally held out her thumb. "Smaller, if they wanted to push it."

A man wearing a three-piece suit walked in, and the room suddenly fell silent. Sally recognized him from the briefing: the corporate veep heading the negotiation team. "We have agreed to a negotiation, with preliminary talks starting at noon," he announced. "As expected, Gorotoland has declared sovereignty over the border territory, and claims that they have recently purchased seventy semi-intelligent Rapier fighter drones, which will assure their victory if war is continued."

"Where did they buy them?" asked Dan.

"At this moment," the man *hrrumph*ed and paused to stroke his mustache," we are unable to determine exactly how and when Gorotoland purchased the RPV drones. Covert has identified a black-tech dealer with a recent large cash inflow, but we have yet to trace that to Gorotoland. We're following it, but this is not a priority item. The point is, they have them. Miss Martel? Has your team finished running this out?"

She nodded. "Yes. With the drones, our computer simulations show that Gorotoland can neutralize the Ngai air superiority. Lacking air cover, the Ngai army will be at a slight but significant disadvantage to the larger Gorotoland force."

The tweed suiter scowled. "Then, as things stand, we will have to forfeit our bond and counsel our clients to accept the revised borders. You don't want to know what that will do to the company's reputation, our cash-flow, or for that matter, your jobs."

Dan spoke up. "But do these RPV drones in fact exist? I'm still not con-

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vinced that I believe the satellite images."

The corporate veep swiveled his head to look directly at Dan. The room was silent. I'm glad it's him who put his neck on the line and not me, Sally thought. Can he be right? How could the recon be wrong? The whole of war-avoidance technology relies on the fact that satellite images can't be bribed and never lie.

"Miss Martel? Is this correct? Is there something wrong with the satellite photos?"

"No." She glanced over at Danny, who sat silently punching one fist with the other. "That is, everything that we've seen so far checks out. We're still checking, of course."

"Still checking? In an hour, when they present their demands, what do we tell them?"

Everybody turned to look at Sally. She licked her lips. "We're working on it. It might be a trick, but if it is, it's damn good. We don't have evidence yet. Stall. No, wait, tell them that we need another look. Tell 'em, ah, we need them to take down the screens so we can check the count."

"And do you have any reason to think they'd do that? They'll argue that we want it to plan an attack. What do they gain by giving us another look?"

"Because wars are expensive," Dan answered, "even for the winners. Just sound convincing. There's no way they'll take the risk of actually having to fight the war if they can prove they'd win if they did fight. Make 'em believe we won't go into arbitration without another look. Tell them that we only counted fifty. If they really have the vehicles, they'll show them again and let us get a good count. They have little to lose, and a war to gain."

"And if they keep them hidden," Sally added, "we'll know they're trying some kind of trickery, and they know we know that. If it's a trick they've got to have a lot of confidence to bet a war on it. I'd bet Euro-marks to donuts they'll do it again, rather than risk our calling their bluff."

"And then will you be able to tell if they're real?"

Dan looked at Sally. "No guarantees," she said. "We'll do the best we can."

"You'd damn well better." The negotiator sighed. "Okay, I guess we have to try. Just get me the answer, okay? And take it for granted that we consider recon and data analysis to have the highest priority. Our ass is riding on this one. Don't blow it."

1 P.M.; Owl-Eye high-gain ground station, Roermond.

Sally climbed down from the three-meter satellite dish to where Dan waited expectantly. "Well?" he asked.

She shook her head. "I checked that bastard out, every square centimeter. Nothing."

"Okay," he said. "I checked all the leads on the analog circuitry inside. If something's there, it's pretty well concealed."

"Damn well. But it would be, wouldn't it?"

"Right." He reached over to the box of equipment, and pulled out the SQUID. A thin plume of white mist rose where boiling nitrogen from the superconducting element vented to the atmos-

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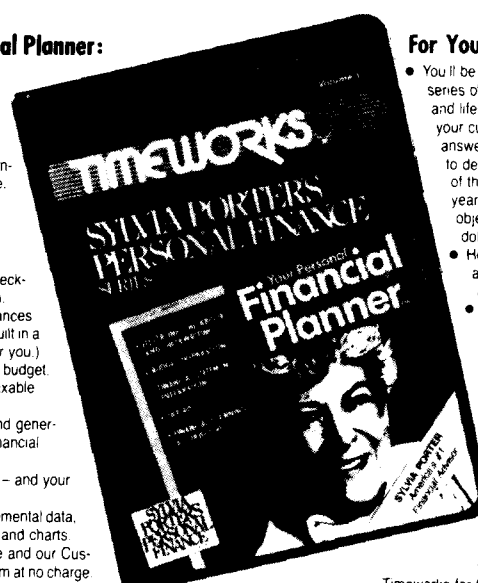

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From America's #1 Financial Adviser

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phere. Sally strung coax cable out to the dish, attaching it to the pick-up with an inductive coupler.

"So we've now bypassed the whole data processing loop. If the signal is here, it comes from the satellite." She glanced up at the sky. The satellite was, of course, invisible. She unfolded a computer screen and plugged it into the SQUID amplifier. "All we can do now is wait."

The Earth filled the screen in shades of indigo and white. "That's the wide angle camera image," she said. "We're looking at the Indian Ocean. In a moment the coast of Africa should come into view. There." She looked over at the time display. "Three minutes to go. Luckily it's clear; we get the sharpest data in the visual."

They waited.

"Here it comes . . . There are the tents . . . They're taking them down; right on schedule . . . high resolution camera focusing in . . . Goddamn it, there they are, all right. Rapiers, a whole armada of 'em. Damn, damn. Now what?" She stared up, following the direction of the dish back into the blue sky where the invisible satellite had to be. There it was, a tiny speck of silver.

"Dan? I think I have something here. . . ."

2 P.M ; Conference room, The Hague.

The representative from Gorotoland concluded his presentation. "As you can see, each scenario results in stalemate. I'm certain that the Ngai will see that pursuing the war further will result in great loss of lives and destruction of property, but no change in the de facto borders. To accept the borders now, or to fight, the results will be the same."

The representative from Ngai stood up. "The simulations you use assume that Gorotoland has air superiority. We do not accept this claim."

The Gorotoland negotiator shrugged. "You've seen the drones. We have even removed the protective sun shields—at your request—so that your satellites could get an accurate count. Do your satellites need yet another look?"

The Owl-Eye negotiator smiled. "You claim to have a force of seventy Rapier fighters at a newly constructed base in the desert near the Gorotoland-Ngai border. Maybe." He turned and gestured to an aide to turn on the projection viewer. The picture showed the barren African hills, viewed from an airplane following the terrain at high speed. The effect was startling, and several of the negotiators had to grip their seats firmly to assure themselves that the room was not, in fact, moving. "Ten minutes ago, Ngai launched an air strike at the Gorotoland air base. The pictures you are seeing come from one of the strike force planes—" the Gorotoland representative got up and sprinted for a phone — "which is just now coming into range of the air base. It's a little too late to tell your clients, I think. If you pay attention, we will discover . . . the truth. One way or the other."

1410 Zulu; Oni Air Base, Ngai Free Republic.

Tommy Gonai smiled, although beneath his full-face helmet no one could see. Even if he was too important to fly a real, manned combat plane, this was almost as good. Cameras in the drone

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delivered pictures to two tiny screens in the helmet in front of his eyes; a computer corrected the view for the millisecond time delay of the signal from the drone. Occasionally his screens would fade slightly, indicating enemy jamming. Such attempts were futile, since even if the control signal were successfully jammed, the semi-intelligent drone could finish the mission without remote piloting at all.

But it was more fun this way.

Ahead of him he saw the forward SISI gun emplacements. A ghostly blue spray fountained out of them, not real bullets but his computer's prediction of where the guns were most likely to be firing. See it, shoot it, Tommy thought. Try to see me. He pulled hard right in evasion, and in the edge of his vision saw Ahmed pull right with him as the three other fighters pulled left. He hugged the deck for a moment, then before the gun could get a fix on him popped up for a radar burst, fired a missile, and peeled around to the right. Two of the fighters had already passed the gun battery; it swiveled and spat, scoring a hit on one, then swiveling back to blow his missile out of the sky.

But a missile fired by Ahmed a moment after his scored dead center, and the gun battery went up in a pillar of yellow flame. Ahmed did a victory roll. "Good shot!" Tommy shouted, "but remember we're not out of the desert yet."

"Roger."

Tommy flipped his view over to the satellite image. His fighter and the three others showed as tiny dark dots; the mylar tents of the enemy airbase as big white squares. They must be alerted by now; they should expect air defense fighters any moment. But as far as he could see, nothing. "Keep alert for bogeys." He risked a quick radar burst; still nothing.

And then the tents were right there, and he had no time to think. Where was the defensive fire? He strafed the first tent with machine gun fire, wasted a missile each on two more, then pulled up hard and around to see what he'd done. The three other craft did likewise.

Tatters of mylar drifted slowly in the slight breeze, and pylons of dark smoke rose from where the missiles had struck. Scattered men fled into the desert. But where the tents had been, nothing. No Rapiers, no aircraft of any kind. Bare desert. He smiled. Victory!

And then his proximity alarm sounded. He pulled up hard, and saw in his reverse screen a drone scrambling out of one of the undamaged tents. Right on his tail. He pulled around in a split S but the hostile fighter followed, spitting heat-seekers. He saw the missiles close on him, and then Ahmed scored on it. As the hostile dissolved in a mist of cannon fire, he pulled into an immelman at max G. One missile passed close on the right and started to curve back for a second try. The other blew off his left wing.

He almost had control when he hit the ground.

Tommy pulled off the helmet to the sound of applause from the crowd. It was surprising how realistic the views delivered to the screens in his helmet were; for a while he had actually managed to forget that he wasn't really in the plane.

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The action was continuing on the monitor screens, but there were no more surprises. Apparently the enemy had only one Rapier. The rest were illusion.

4:30 P.M.; Owl-Eye Corporate Headquarters, Amsterdam.

Sally walked out of the briefing room to where her team waited. She was smiling. "So they reached a settlement?" Dan asked.

"Yeah. Ngai got a complete surrender: return to the original borders, rights to inspect Gorotoland territory to make sure they don't try a similar trick again, reparations for the families of the people killed in action, and a big cash bribe to keep them from counter-invading.

"Not to mention video rights to the battle sequences. That could be worth a lot; not many battles are actually fought these days. We're big heroes, it seems. To the company, anyway."

The computer jock seemed almost disappointed that the war hadn't gone on. "What was the trick they pulled, anyway?"

"Oh, didn't you hear the explanation? It was so simple, we almost missed it. Our satellite photographs the area, and downlinks the photos in a narrow beam to the ground station, right? So they just took a balloon, just a big old child's helium balloon, guy-lines to hold it in position right smack in front of our receiver. The balloon carries a tiny radio receiver and a computer and a transmitter. The computer recognizes the pattern of the mylar tents and the desert surrounding them, and when it receives photographs that show the mylar tents are being removed, it broadcasts an image of the RPVs. Since the balloon is a thousand times closer to the dish than the satellite, its signal is a lot stronger, and that's what we see."

"Cute trick." The cojock was thoughtful. "You know, there's a lot of implications to that. You could use that trick for a lot of things. People won't be able to accept satellite images so quickly anymore. It could lead to a return to real wars."

Sally patted him on the shoulder. "I wouldn't worry about it. The only way they could do it on us is because for a tiny country like Ngai, we have only four or five satellites on recon, and a small enough number of ground stations that it was possible to cover them all. If, say, somebody tried it on one of the superpowers, there's no way they could get all the dishes covered. Besides, now people are going to be watching out. A trick like that can only work once."

"Once was just about enough."

"Just about," said Dan, "but not quite." ■

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on gaming

Matthew J. Costello

In a little over a year and a half it will be the twentieth anniversary of the U.S. landing on the moon. It's incredible to think that something that had been a dream of spaced-out romantics as well as hard-edged rocket scientists turned out to be so mundane.

With no drama, and an icy beauty, the moon landing of some guys with the right stuff—but no poetry—couldn't compete with the technicolor craziness of 1969. Nixon had his big trip, and the rest of us, well, we had ours.

But here's the thing I find really remarkable. Think of the distance that we covered in the twenty years from 1949 to 1969. Then, think of the past twenty years.

What happened to the future?

Despite *Voyager* and the Space Shuttle, many of the big dreams of the space age were let go. No moon colonies. No Mars expedition. And no earth orbit stations.

But these days, the computer will let you simulate just about anything. Electronic Arts, which seems to grow more ambitious and creative with each new game, has just issued *Earth Orbit Stations* (Electronic Arts, 1820 Gateway Drive, San Mateo, CA 94494), and it's an exciting program. The game opens with the now quite natural theme, the "Blue Danube." There are two disks in the game, which include the basic program, a mission disk which covers everything from research to setting up advanced stations and exploration, and an archive disk for storing information. This is outer space for the twenty-first century entrepreneur.

Upon assuming your post as a Space Director, you are welcomed to your position by the Federal Director, who tells you that "private enterprise in space is our goal."

The graphics are sleek, appropriately high-tech, and the game uses a personalized, "HAL-like" tone in talking with you—saying things like, "I need the archive disk."

Played completely by joy stick, the EOS screen displays four different things—a station window which will show your space station as well as shuttles, a command window, a tool and view window, and an information window.

The goal is to turn your station into a profit-making concern. A station needs modules for life-support power, but you'll also have to invest in modules devoted to commerce and research.

You start by checking your income and the *EOS News* (to see what might be profitable to engage in). Then you can have the fun of building your space station. You select from a variety of modules, including connectors, Command and Logistic modules, as well as life-support systems for the station. The station is built on a grid, like an electronic erector set, and you can rotate the various modules you purchase to fit

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THE WORLDS I USED TO KNOW

Rick Shelley

By now people are used to the idea of social responsibility to groups as large as nations, and have started thinking in terms of the planet as a whole. But it may go *much* further than that . . .

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"The world ended on July 2, 1993."

Two men sat at my outside table at André's, the sidewalk café on Flatbush, in the area known as Little France since so many Frenchmen came to America after the Armistice in '33 left Kaiser Wilhelm in possession of the Seine basin. Three inches of height was the most noticeable difference between the two men. The taller one started the conversation.

"That's not a very sociable way to celebrate Independence Day," I said, trying to be polite without encouraging further chat.

"Your name is Edward Villiers, age thirty-eight. Wife: Madeleine. Children: Amy, eighteen; Edward Junior, fifteen; and Charles, nine."

"Who are you?" I demanded, annoyed that total strangers should know so much about me.

"We need your help," the shorter man said.

"Then call my secretary."

"Not your architectural services," the tall one said. I stared at him, but he didn't disappear.

"You said the world 'ended,' past tense, in 1993. This is 1977."

"Yes," the tall man admitted, "a slight inaccuracy. I should have said, 'The worlds ended on July 2, 1993.' "

"Yes, worlds," the other agreed, "*all* of them."

I reached for my wallet and pulled out a dollar to pay my tab. There was no reason to stick around and listen to that kind of nonsense.

"You're the only one who might be able to stop it," the tall man said.

"Today is October seventh," the other said as I got up. "Two weeks from today, your wife and two oldest children will be killed by bank robbers." Before I felt sufficiently in command of my temper to speak, he added, "We'll be here every day at this time. When you're ready to listen . . ." There was pity in his voice. I had to hurry away to keep from striking him.

I was nearly home, in Bensonhurst, before I calmed down. André's was ruined for me. I'd never be comfortable there again. And I couldn't tell Madeleine about my bizarre encounter. It would upset her no end—she was so sensitive—and that would upset me again, and so forth.

André's was only a block from my office. On those days that I drove by at the proper time, those men were always there. Looking back, it's easy to find ways I might have handled it differently, but there was simply no way a sane man could give credence to what they said.

—Chick had a Cub Scout meeting after school on the twenty-first. Madeleine was out back with Amy and Ed—we lived in a new townhouse block, homes lined up around the square with common area and private yards in the center—barbecuing supper since the weather was unseasonably warm. The bank robbers had already robbed their bank. They drove into the center of our block trying to elude the police. There was a murderous shoot-out.

The police were skeptical but promised to check out my story. Maybe they did. I was too busy and distracted to keep track. There were arrangements to make, relatives to call, grief to bear. My parents took Chick home with them after the funeral. I promised to join them in Chicago as soon as I could.

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It was a week before I returned to André's and sat outside despite the chill. I wasn't sure what I would do when — if—the men showed, but I did intend to get some answers. For an hour I was the only customer at an outside table. The waiter kept hot coffee coming. He had offered his sympathy and must have accepted bereavement as explanation enough for my behavior, but people passing by looked at me as though I had to be crazy, sitting outside in 40-degree weather.

They arrived at the same time as before and sat across from me. "It couldn't be avoided," the tall man said, with a proper tone of respect.

"Why not?" I felt suddenly empty, drained of any emotion at all.

"We had to find a world where it couldn't," the short one said. I couldn't read anything in his voice.

"Why?" I didn't know enough to ask more. Nothing they said made sense.

"This is going to take some time," the tall one said. "Could we talk somewhere warmer?"

I realized that it would be stupid to go anywhere with two peculiar men who knew about the murders weeks in advance. But it *was* getting cold. The taller stranger seemed to sense my misgivings.

"We could go inside the café," he suggested. I agreed. André's was quiet but not too secluded. We got fresh coffee inside. I had mine with brandy.

"There are many worlds," the tall one started and I shook my head.

"Names first," I said.

"They will mean nothing to you," the short one said.

"Nevertheless," I needed more than *the tall one* and *the short one*.

"I'm Andrew Kole, with a K." The tall one. "My partner is Harvey Brit."

"There are many worlds," Brit said it this time.

"You're not astronomers."

"No," Kole admitted. "Perhaps I should approach this from a different angle. Do you read much science fiction?"

"Much what?" I asked, wondering at the contradictory juxtaposition.

"Science fiction, scientific romance, scientific tales of wonder, anything like that," Brit said.

"You mean like *Twenty Thousand Leagues Under the Sea*?"

"Perhaps more modern work of the same sort?" Kole asked.

I shrugged. "I read Verne in high school." Why, I wondered, would anyone want to read dull fiction about science? M. Verne was unique.

Kole and Brit exchanged strange, almost melancholy, looks.

"No speculation about space travel or weapons that could destroy the entire world?" Brit asked. He sounded disappointed.

"Where do you two come from?" I demanded. Space travel? Weapons that could destroy the world? Maybe that's not as dull as the science I learned in school, but *really!*

"I was born at St. Stanislaus Hospital in the next block," Kole said.

"There is no hospital in the next block," I told him.

"There is in the world I come from."

"And the Kaiser abdicated in 1918 after World War One," Brit said. "The

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Second World War lasted from 1938 to 1947."

"Atomic bombs, hydrogen bombs," Kole said. "Men landed on the Moon in 1971. In some worlds, it was as early as 1962."

I looked back and forth, watching each man as he spoke. "I don't know what asylum you escaped from," I said, "but I'm surprised the police didn't lock you up." There were a number of fine mental institutions in Little France. The archdiocese and the French Expatriate Association had the best. Both dated back to the late 30s, when a lot of exiles experienced serious adjustment difficulties.

Brit chuckled. "Police rarely arrest police." Both men took out thin wallets and opened them. There were the gold badges and light green ID cards of the Federal Security Police. I felt colder than I had outside.

"Many worlds," Kole said, then he paused. I guess he was trying to decide how simple he had to make his explanation to make sure I could understand it. I didn't resent that at the moment—I was still too upset that these lunatics were from the FSP. You never really expect to be confronted by the government watchdogs. It's always somebody else.

Finally, Kole continued. "Parallel worlds, alternate realities. Technically, it's more complicated, but basically, whenever a major event offers more than one possible outcome, each potential result spawns a new branch of reality, a new group of realities. Minor events, individual choices—to the most minuscule level—provide diversity within each major group."

"Like a tree," Brit offered. "You start with a massive trunk, major limbs, heavy branches, light branches, twigs, leaves. A change might cause one major fork and several small branches for minor possibilities."

"I don't have any idea what you two are talking about," I said.

"Would you like to go to a world where your family didn't die?" Brit asked.

"Are you saying it's possible?"

"Possible?" Kole said. "It's the entire point of this exercise."

Perhaps, I thought, it was all a bizarre reaction to grief. *I* was the crazy one. That seemed the most likely explanation. I may have missed some of what Kole and Brit said after that. They spelled each other as though they had one brain driving two mouths. I'm not even sure how long they continued. In this other world, my younger son grew up bitter and got into politics, radical politics. "Another Hitler," Brit called him, but the name meant nothing to me then. But Chick was responsible for a war so deadly that the entire world was destroyed—and more than that, the effects spilled across the lines separating the parallel worlds and destroyed them all—not just one branch, but the entire tree. In this other world, Madeleine was raising our children alone. I had died just after Charles was born, long enough ago that when I showed up, it would just seem that I looked a bit like Ed Villiers.

"The world we're really trying to influence," Kole said, "is one parallel away from the world we're sending you to—close enough for your actions to cause feedback changes there. I can't

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begin to explain how *that* works. You don't have that background. It's all very delicate." Okay, they were talking about at least two other worlds—more confusion, but it scarcely mattered at that point.

I never said I would do what they wanted. I didn't believe any of it. It was like being in a dream, knowing it was a dream—but not being able to do anything about it. I asked, "How do you get from one world to another?" Expecting a fancy show ending with a lame excuse (like: "The thingacouple shorted out the whoozis") for it not working, I agreed to look at their device. Who can refuse FSP agents? Even if they're daft as polar bears in the Sahara.

We left André's in their car, a large gray sedan, the kind of anonymous four-door vehicle government agencies seem to favor. We all sat in front, me in the center, Kole driving—toward Manhattan. The car itself was their device, Kole explained. It did have extra controls on the dash. According to Kole, you only had to set three pairs of coordinates and push a button. Near the end of the Brooklyn-Battery Tunnel, he pushed it. The lights in the tunnel flickered. When we emerged, the sun was too bright, there were no clouds, we were heading east instead of west, and we had come out of a building rather than a tunnel. I felt a pinprick on my right wrist, but with so many impossible things happening, I didn't worry about that.

"Chicago," Kole said. "Congress east from the Main Post Office."

My vision got fuzzy. A low hum started in my ears. I couldn't speak or move. I realized that Brit had drugged me when he started talking in a monotone. "You are Lawrence Joseph Brent, age thirty-seven. You met Ed Villiers in high school. . . ." the words droned on, imprinting themselves on my mind. I got a lengthy briefing on Brent, his life, his world, and his knowledge of the Villiers family. Then there was another pinprick.

"What's today's date?" Kole asked.

"Tuesday, September 5, 1979," I said idly, only slowly regaining any sense of alertness. We were headed north on Michigan Avenue. In my world, I knew Chicago. I grew up an hour south of the Loop. My parents now lived in Arlington Heights. But that wasn't *my* Chicago. Then the date sank in.

"What happened to the two years and odd weeks?" I asked.

"Different time tracks," Kole said. "We can get to any recent time and place."

My mind was running on two tracks, which may be why I was so slow. I was still Ed Villiers, but I was also Larry Brent. Once I figured that out, "Ed" and "Larry" seemed to know whose turn it was. Brit handed me a wallet with money, credit and I.D. cards, membership cards for several writer's groups —Brent was a moderately successful author; keys to a car, an apartment, and a safety depost box; and so forth. Then, Brit said, "When you're ready for us to pick you up, take this cigarette lighter, press the basket down and flick this button." He demonstrated. When the windproof basket was depressed, a tiny button on an inch-long stud popped up next to the wheel.

We stopped on Wells, three blocks north of North Avenue. Brit pointed at

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a house. "That's your door at the left of the porch. You've got the upstairs flat. The old woman downstairs is your landlady, Agnes Reuss. You've dealt with her by telephone and mail. Your belongings were delivered last Friday. Everything's ready for you."

"How long will this take?" I asked.

"We won't know until our survey people spot the changes you create," Kole said.

"When?" I needed a better answer. My son needed me in my own world.

"The change could show up any time," Kole said, "once you've said or done whatever it takes to change the kid's character."

"What if nothing shows up?"

"The worlds ended on July 2, 1993," Brit said.

"I'm not staying here fourteen years."

"When you go home," Kole said, "you'll get there the day you left. There won't even be a parking ticket on your car."

"That won't help if I've aged so much my son can't recognize me."

"That's your new car in front of us," Brit said, ignoring my objection. "Across the street, two doors up, is the Villiers home. It's ten after two now. Charles gets home from school at 3:30. His mother picks him up on her way home from work. Amy and Ed get home between four and five."

"Remember," Kole said, "they're older than your kids. "Amy is twenty, a junior college sophomore. Ed's seventeen and Charles is eleven."

Brit opened his door and got out so I could. I did get out—my mind was still a little foggy. I hadn't decided to do anything. Brit got back in the car, closed the door and rolled down his window. Kole put the car into reverse. Rather than protest, I stepped up on the curb, out of the way. It must have been something Brit said while I was drugged. Kole drove off and I was stranded.

When the car turned the corner, I went to look over my new home.

The upper flat was roomy and light. In front, a living room extended the width of the house, opening onto a balcony over the porch. Dining room and entry foyer; kitchen, pantry, bath; bedroom and office in back. The office had desk, files, typewriter, books, and writing supplies. I glanced through some of the books. A dozen were by Larry Brent. Those, and the rest of the novels, were science fiction—which explained the melancholy looks Brit and Kole exchanged when they learned I wasn't familiar with the subject. Reading Brent's books had to be a top priority. The photo on the back covers might have been me, ten years younger, but wasn't.

I took the book with the earliest copyright, stopped in the kitchen to check the icebox—fully stocked, then went out to sit on the balcony swing. It was only then that I wondered what happened to the real Larry Brent. There *have* been rumors about the FSP's methods.

A royal blue car parked across the street. It *was* Madeleine who got out, except for the clothes. This one was wearing a pantsuit, which mine would never have done. And Chick, he looked, well, older. Two years? That might be right. Then they were gone, inside, and I started breathing again. I had seen my wife's alter ego and an older version of

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my son—or had I? I was a fake, why not them? Was the whole thing an elaborate hoax? Crossing the street and knocking on Madeleine's door might provide the answers. I had to do that before long, no matter what—but not yet.

The first days were miserable for me. I had trouble keeping my mind off the family I had buried. Solitude is hell at a time like that. I found my way to the parish church, introduced myself, and spent time talking with an older priest. The Church, at least, remained. At home, I read all of "my" books and some of the other books and magazines, getting to know the science fiction I supposedly wrote for a living. There were even some stories about alternate worlds, and a lot of that didn't jibe with what I had been told. Changing history wasn't—according to the stories—possible. All you could do was cause more parallel worlds to branch off.

I worried about that . . . some.

I walked around the neighborhood, drove into the Loop, read papers and watched television. It was definitely not my world. It had a lot mine didn't—jet aeroplanes, the Sears Tower that was just being started back home, miniskirts, hippies, and a lot more. I met my landlady and saw more of my almost-family from a distance. But I couldn't work up the nerve to cross the street and introduce myself.

Sunday, I was determined to meet them. The parish church two blocks away had two Masses. *My* Madeleine always insisted on early Mass. The service itself was depressing. Everything was in English—no sonorous Latin, no airy French hymns. I sat through both Masses but the family didn't show. I had assumed they would attend the local parish and not drive to some other church. I never considered that they might skip a Sunday. In the twenty-two years I knew *my* Madeleine, the only Sunday she missed was the day Amy was born.

After church I walked over to Wells, south of North Avenue, to window-shop. By the time I turned toward my flat, it was almost one o'clock.

"Excuse me, aren't you Larry Brent, the writer?"

I turned and there was Madeleine. Alone.

"Yes, and you must be Madeleine Villiers. You haven't changed much."

"I didn't know we'd ever met." She seemed startled.

"Not exactly met," I said, "but I've seen your picture. I knew your husband before you did." The sadness in my voice wasn't feigned.

"Then you *are* that Larry Brent. I was never really sure."

"Probably." I smiled. "Also your new neighbor. I've been meaning to pop across to say hello, but I haven't had the nerve."

"I don't scare you, do I?" Madeleine asked, laughing.

"No." That wasn't true. "I thought I might see you at Mass."

"I haven't been much since I got married," Madeleine said. "My oldest boy, Eddie, reads all your books. That's how I recognized you."

"My evil past catches up with me." Madeleine laughed again. I liked the sound. Her laughter was less inhibited than my Madeleine's.

"Since you're a new neighbor and an

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old friend of Ed's, perhaps I could invite you to dinner this evening."

"I'd like that." At least, I hoped I would.

With a little encouragement, I might have stayed home and drunk myself into a revolting state, I got so nervous. A hot shower, a cold beer, and fresh clothes helped, and I was able to cross the street. But I whispered *Hail Marys* until Chick answered the door.

"Hi, Mr. Brent. Come on in." He led me to the living room. Madeleine came in wearing a light sundress with a scooped neckline, too daring for my Madeleine but (as I had already seen) quite modest for this world.

"Hello, Mr. Brent." I returned both her greeting and her smile. "This is Charley, my youngest."

"Hello, Charley," I said, reminding myself not to call him Chick.

"Have a seat and relax," Madeleine said, guiding me to the sofa. "Dinner will be ready in ten minutes." I sat. "Some wine?" I nodded and Madeleine brought it to me, then returned to the kitchen.

"Are you really the writer?" Charley asked.

"That's what they tell me."

"I've read all your books."

"Your mother mentioned that your brother reads them," I said.

"I read everything *he* does," Charley said, a bit defiantly.

"I probably shouldn't ask, but what do you think of my books?"

"Some are okay." I'd been a "writer" just five days and I was learning about critics. "Where d'ya get all those weird ideas anyway?"

"They're all around," I whispered. Charley looked startled, then laughed. "Actually," I said, "life can be weirder than fiction."

Charley thought about that, then nodded. He was starting to say something else when his mother returned to announce dinner.

Madeleine sat at one end of the table and I sat at the other. Eddie and Charley were to my left. Amy sat across from them. The first moments at the table were horrible. Memories ate big chunks out of my mind, flashing pictures of three corpses and a crying little boy. I bit my tongue so hard I could taste blood before the flashback faded.

The food was excellent, as far as I noticed. I had that split-mind sensation again. Larry was out front talking. Ed tried to memorize every detail of the evening.

The family: Madeleine was much like mine, face not as pale, more stress lines at the corners of her eyes. She was an interpreter for the French Consulate. The children were older than my memories, but I had been warned about that. Amy was a beautiful woman, quite like my Madeleine at the same age—hair a rich gold, green eyes that looked too large for her beatific face. She tutored students who were having trouble with French, part-time. All of *my* family was fluent in French too; it was Madeleine's first language. Ed Junior didn't look so gangling and awkward—two years had given his body time to catch up with itself. He was "taking it easy" his senior year in high school, snap courses, no sports. And Charley . . . he hardly seemed the kind of lad who could grow up to destroy the world. Worlds. It was

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ludicrous. The Charley in the next world couldn't be *that* different from this one, or my own. This Charley was a whiz, starting seventh grade. That figured. My Chick was a brain too. Charley had been skipped one grade and Madeleine refused to let them jump him ahead any farther.

After dinner we all went to the living room, for a few minutes. Amy and Charley had homework. Eddie was going out with friends.

"Maybe I should leave too," I said when Madeleine and I were alone.

"Please, don't. It's so nice to have someone to talk to for a change."

We talked about Madeleine and her family, and about the phony me. While "Larry" talked, I tried to sort out what the Church's position would be if I slept with this Madeleine who wasn't quite my wife or the mother of my children. When the fantasies got out of hand, I knew it was time to go.

"Thanks for the wonderful dinner, Madeleine," I said at the door—we had switched to first names quite early. "I can't remember when I've had a nicer evening."

"It was nice having you over."

Walking home, I felt better than I had since the shootings. After my initial panic at the table, I ended up really enjoying myself. I even slept well. There was no longer any room for grief.

Over the next weeks, the persona of Larry Brent started to fit. I read acres of science and science fiction, and even started trying to write—though I shredded my first half dozen stories. But the typewriter made the proper noises for a few hours each day and people could hear that. The Villiers accepted me as a friend. Some afternoons Ed or Charley would stop by to talk science fiction. When they wanted to borrow a book (I was accumulating quite a library), I was happy to oblige. I took the Villiers out to dinner several times and ate at their home just as often. There were other outings—museums, movies, both zoos, and so forth—with some or all of the Villiers. At first it was usually Madeleine, Charley, and me. Sometimes one or both of the older kids went along. Then Amy started to go on all of our outings—after breaking up with her latest beau, according to Madeleine—and she started talking science fiction almost as much as her brothers.

"It's amazing the changes you've made in them," Madeleine said the last day of October. We were walking south on Wells, going to lunch. Madeleine had the day off for some French holiday my world didn't have, and her kids were all at school.

I chuckled and watched my breath steam. The weather had turned cold and there was talk of snow flurries for the trick-or-treaters that night. "It's been fun being around them," I said, "and you."

"You remind me a lot of my husband," Madeleine said, and I sucked in my breath. "Maybe my memory's playing tricks, but you sound like him, and I think Ed might have looked like you if he had lived." She was always matter-of-fact when she mentioned him. Her grief was old enough that it didn't show.

"There was a time," I said, taking an inexcusable chance, "when you

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couldn't have told us apart." Madeleine stopped walking and turned to me.

"I was thinking the same thing," she said.

It was too chilly to stand still for long. "I'm surprised you never remarried," I said, anxious to change the subject as we walked on.

"Not many men are eager to start a marriage with a big family." Madeleine laughed. "They'd rather do it themselves." I chuckled. This Madeleine had a broader sense of humor than mine.

All in all, it was shaping up to be a fine day. I'd finally written a story I wasn't totally ashamed of and sent it to a magazine that had published some of the real Larry Brent's work and I had started a new story based—very closely—on my own adventures. I didn't have an ending for it yet, but I was almost certain it would be a happy one.

Especially after Madeleine slipped her hand in mine.

Lunch was cheery. I started to wonder how Madeleine would react to the truth. After all, the concept of parallel worlds was known in her world, in fiction, even in some speculative nonfiction. Walking back up Wells after lunch, we strolled hand in hand, chatting, laughing. The clock on the bank said 12:10 when we crossed North and I figured that there would be time for a little romance before Charley got home, if Madeleine was interested. She didn't waste much time suggesting that she might be.

"My kids know your place as well as their own, and I haven't even seen it."

"I could give you the fifty cent tour, fix coffee or whatever."

" 'Whatever' sounds interesting." Her eyes and voice left no doubt as to what she meant.

I tried not to walk too fast, but I was . . . very eager. Madeleine seemed just as . . . eager. We never actually *ran*. That would have been undignified, uncouth, and disgusting. But we did walk briskly—until Madeleine spotted the black limousine with diplomatic license plates double-parked in front of her house.

"Damn!" she said. We stopped. She turned and took both my hands. "If they've sent a car, it means work."

"I thought this was a holiday."

"In France. It must be important."

I sighed, knowing our afternoon was lost. "When you get a chance, come over and we'll work on that 'whatever.' "

"It's not easy finding a time when none of the kids are around."

"We'll find a way. I'm into creativity, remember?"

We laughed to cover our disappointment, then I took her to the limo. The consul sent his regrets, and so forth. I said good-bye and went home. Madeleine went into her house for a moment, then came back out and got into the car. I watched it drive away.

I tried to work but couldn't. Reading was also a bust. I couldn't concentrate. Finally, I got a beer and stood at the front window—daydreaming, almost blank. Charley got home a few minutes late—with his mother busy, he would have taken the bus. I saw him go inside, come back out, and cross the street. I was ready when he knocked.

"Come in, Charley." He did.

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"Mom's working. Can I borrow a book?"

"Help yourself." We had an arrangement. The boys could borrow anything that didn't have a bookmark showing that I was currently reading it. I didn't pay much attention to Charley that afternoon. He may have been around ten minutes or an hour. I was too frustrated to notice.

I didn't sleep well that night either. Madeleine was too much in my dreams. One crazy sequence had me making love to both Madeleines at the same time while infinite queues of Madeleines waited their turns. They all held little plastic number tags. Brit and Kole were handing out the numbers and a bass voice kept announcing, "Now being served . . ." but I could never hear the number.

I got up early and ate breakfast while I watched the news. About eight, I showered, dressed, and went to my office. My story, the one about my own adventures, was where I had left it, pages neatly stacked, last one still in the typewriter. But I couldn't work, not a line. After a while, I went to the living room to stretch out on the sofa and read. After ten slow pages, I heard a knock at the door.

Amy was there, wearing a short fur-trimmed coat over blue jeans.

"Come in." I moved aside so she could. "No school?" That sounded less parental than, "Why aren't you in school today?"

"Mid-terms." Amy shrugged off her coat. Her sweater was almost the green of her eyes. "I don't have any tests today. You busy?"

"I should be, but I'm not. Have a seat." By that time we were in the living room. "Can I get you anything?" Amy shook her head, then settled at one end of the sofa. I sat at the other end.

"Something bothering you?" This Amy was always more high-strung than mine, but more so than usual that morning.

"Not really." My Amy was a poor liar too. I sat back and waited.

It only took a moment. "Are you in love with my mother?"

I met her stare without flinching—God only knows how. "I don't think we've known each other long enough for that," I said.

"You can't be *that* old fashioned." Okay, I knew my manners were from another time and world—but I thought I was doing better.

"I can't help being what I am," I said.

"I'm not so sure," Amy mumbled. She curled her legs up under her.

"Your mother reminds me of somebody I used to know."

"That's the corniest line ever!" Amy said, laughing. My cheeks got warm. That old line about "words can never hurt me" isn't quite right. It hurts to have a cliché thrown back in your face.

"Do *I* remind you of anybody?" Amy asked, teasing gently.

"As a matter of fact," I said with a straight face, "you do. The daughter of the woman your mother reminds me of."

Score one for the phony. Amy's laugh was almost hysterical. When she stopped, I asked, "Why the sudden interest?"

"I don't know. Mom said you went to lunch yesterday. Maybe it's just curiosity, or normal mother-daughter ri-

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valry." Her voice denied both. Again, I made the mistake of waiting her out. Amy seemed quite agitated, but I couldn't imagine why—certainly not because of one lunch. Barely loud enough for me to hear, Amy mumbled, "Oh shit. This isn't working out right." I was startled by her language, but worse was to come.

"I do know why I asked." There was something new in her voice—resolution. "Jealousy"—I only had time to raise a questioning eyebrow—"because I want you to love *me*."

I was dumbfounded. Before I could say anything, Amy pulled her sweater over her head, paused to make sure I saw that she had nothing on under it, then flung herself the length of the sofa. Her arms locked around my neck and she started kissing me as passionately as my Madeleine had ever done.

And she looked so much like my Madeleine did when we met.

There was no time for rational thought. My body started to respond but all my mind could grasp was, "No, not with my daughter!" That this Amy was *not* my daughter didn't penetrate my shock and may not have made any difference. I panicked at the thought of incest, or pseudo-incest, and my body was defeated. I disengaged, pulled her arms from around my neck, and pushed her away. Not far . . . I didn't have the strength for that.

"No"—a strangled croak—"I can't.

For a moment, Amy stared blankly at me, gasping with passion or disbelief, breasts heaving, blushing from her cheeks to her nipples. I *tried* not to see, but I couldn't turn away or close my eyes. I was breathing heavily myself. We both needed time to recover.

"You're not gay?" Amy made no move to cover herself.

"No." Two months had been enough to learn what that meant in her world, but not enough to get used to the casual way the subject was treated.

"Then it must be because of you and my mother."

"I don't think so." I tried to sound gentle, but it wasn't easy. "It's more because of the people you remind me of."

Amy started sobbing heavily. "I've made an ass of myself," she finally managed. The crying got worse. There was nothing to do but hold her and let her cry on my shoulder until she got it out of her system. With my arms around her, touching her soft warm skin, it was almost impossible to keep from getting aroused again, to keep flickering fantasies from nipping holes in my resolve. When Amy shut off the waterworks and quit shaking, I released her, then picked up her sweater and handed it to her. She stood and turned her back while she put the sweater on, then took a couple of steps toward the front window. I stood up too. I was still shaking.

"You must think I'm terrible," Amy said, her voice weak.

"I think you're a beautiful woman. If it wasn't for the memories . . ." I had to let go of that. Amy didn't reject the cliché now.

"These people we remind you of . . ." Amy turned toward me. Her face was streaked with tears, her hair badly mussed.

"My wife and daughter," I said as softly as I could.

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"Oh, God." She moaned, then asked, "They're dead?"

"I guess that's why I moved here." That wasn't far from the truth. "I had to get away from the memories."

"And I've made it worse." She was ready to start crying again.

"Maybe you've just made me see that I have to get back to living." When I crossed to her and held her, when she held me back and put her head on my shoulder, there was no thought of sex. We were just—almost—a father and daughter, comforting each other.

"I did make a fool of myself," Amy said.

"No." I'd have said that regardless, of course. I pulled back and turned her face toward mine. "You did something special, something I'll never forget." I was back to clichés, but that was what Amy needed right then. And something more. "Our secret, I promise. Okay?"

She nodded and sniffled and tried to smile.

"You'd better brush your hair and fix your face," I suggested, gesturing toward the bathroom, "or folks'll think I've been beating you."

She almost laughed. When she finished in the bathroom, she was ready to leave, still looking like she wanted to cry. At the door I kissed her lightly on the forehead. "Cheer up, Amy, please?"

I had to get out. I don't know how I stayed in control until Amy left. It wasn't just her pass that unnerved me, but the fact that I had wanted—desperately —to respond. She looked so much like my Madeleine did when I fell in love with her. But I couldn't have lived with myself afterward, no matter how many excuses I paraded across my guilt. My dreams of staying with that world's Madeleine were crushed. Sure, Amy and I put the best face we could on what happened, but neither of us would ever forget. The memories would sour everything, sooner or later.

I used the lighter to signal Brit and Kole. I didn't have a plan, just an insistent, *I have to get out*, bashing the sides of my head like a caged rhino. I knew that Kole and Brit might not care to spirit me away if their surveyors found that I hadn't succeeded. If they resisted, I would have to force them to take me home—but how can you force FSP agents to do anything? I didn't have a gun and probably wouldn't have been able to use it if I did. Maybe I could slip them a mickey, I thought, but there was no chloral hydrate around and that was the only knockout drug I knew about. "I" had used it in a book. I had sleeping pills, but they weren't very powerful. On my bad nights, two pills weren't enough to put me to sleep. There was an old brown pharmacy bottle labeled atropine under the kitchen sink. I vaguely recalled atropine from my Army Reserve training, an antidote to nerve gas but dangerous to use. I looked it up in my desk encyclopedia: atropine—belladonna, nightshade; antispasmodic, narcotic, analgesic. It might work if I could guess an effective dose. Maybe mix it with the sleeping pills.

I was that panicky. I didn't want to add to my sins by killing anyone, but I had to get away, no matter what. If I doped the FSP agents, I'd have to run and keep running. Take their device. I

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had seen it operate and I had a list of worlds they had checked to find a place for me to work—with all the necessary coordinates. The device couldn't be *too* complicated, these were government agents, cops. There might even be an instruction manual in the glove box.

I couldn't afford panic for long. I had to find a way out. If there was one. Kole and Brit? Well, after two months in a world that knew the concept of parallel worlds, I could ask better questions than I had been able to before they dumped me. Maybe the answers wouldn't help, but . . .

By the time they arrived, I was halfway calm. I had made my preparations. If they agreed to take me home, I was packed. If not . . . well, I was ready for that, too. I tried to explain what happened, why I had to get out.

"You have to keep trying," Kole said. "There's no change yet."

"I'm just going to make things worse."

"What could be worse than the end of all the worlds we know?" Brit asked. This time it was "all the worlds *we know*." I asked about the difference.

"The worlds we know are the only ones that can matter to us."

I didn't need bad philosophy. "I'm not quite as naive—or stupid—as I was when you hooked me into this."

"What's that supposed to mean?" Kole's voice was frigid.

"Parallel worlds. I've read up on them here."

"This world has no knowledge of parallel worlds," Brit said.

"But a wealth of speculation." I was standing. They were sitting. That might not give me any advantage, but I was too nervous to sit.

"World A blows up. Afterward there are two or more world A's. One is destroyed. One survives because it didn't really blow up. Maybe several others have varying degrees of damage. A graph of points satisfying an equation in two unknowns. Something like that. The graph doesn't disappear."

"Not quite," Kole said. He looked disturbed. Brit just looked angry. "Maybe it was that simple once. Worlds branched apart and went their separate ways, ignorant of each other, safe in their isolation. But now, so many worlds are linked together beyond the original forks. Those links are weaknesses, holes in the fabric—the 'superspace' that contains all the parallels. Once one timeline learned to travel to others, new links were formed. Like a vine that's overgrown a tree, climbing from branch to branch, locking them together. 'All the worlds we know.' "

"You people screwed it up."

"That's one way of looking at it," Kole conceded. "If one world has a doomsday war, it can take out any other world that's too tightly linked to it, any world connected by too many of these artificial paths."

"That's still not all the worlds," I said.

"I wasn't finished." Kole said. "If the world is a core world, a major branch, the effects can be magnified so much more. It can take out a big chunk of worlds at one time."

"You're starting to muddy the water." I said.

"The world we're trying to save." Kole said—a *patient* voice now, "is im-

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portant. We don't know that it's *the* main line, but it represents a high order of probability, a norm rather than a deviation. It's the hub that spins off all the worlds we know. If it goes . . ."

"Don't you see," Brit demanded, "there's no escape. If we run to a new world, we bring the holocaust with us. We can't escape."

It seemed to be a particularly just sort of justice—for them.

"Those other worlds, the ones we haven't been to, the ones that aren't tightly linked to the one that we're trying to save," Kole said quietly, "they may be condemned anyway. Our scientists think that the sudden destruction of one large bloc of worlds will create a void, something like a black hole, but instead of sucking in matter or light, it will suck in the entire fabric of space-time. Implosion—everything caves in. Then a new explosion. In fact, they think it's happened at least once before."

"You *have* heard of the Big Bang, haven't you?" Brit asked.

"And I was supposed to be your quick fix for the end of everything?" Something was beating me about the brain, from the inside. I had just about talked myself into believing that Kole and Brit were con artists, setting me up for something. I couldn't guess what or why, and some of what they had told me was obviously true—I *was* in a world that wasn't my own—but everything I had read about parallel worlds had convinced me that they were dead wrong about *Götterdämerung*.

Until that moment.

"You're all we have left," Kole said. "Tight restrictions on travel—especially to *that* world, limit our options. Maybe it's too little, too late." He shook his head. "No, our options were limited even before that. It's . . ." He tried to find another way to say it and failed. Brit wouldn't even meet his eyes. Without any wavering, I was convinced that they were right—right enough that the details weren't important.

"Back home," Kole said, "they're trying to limit the damage by outlawing new travel, trying to distance our 'present' from open avenues. But nobody believes it will work. The equations don't offer that much hope."

I took a deep breath. Maybe they were leveling with me—or maybe it was just the "good cop/bad cop" charade I saw so much of on television. One thing hadn't changed. Even if saving all the worlds did depend on me, I had to get out, away from that place. I'd have to try to do it on my own, find a way that didn't outrage morality or destroy what was left of my sanity.

"Unless we succeed—unless *you* succeed—we can't even go home to die with our families." Kole's voice quivered dramatically. I got his message though.

"I need a drink," I said. "You two want a beer?"

They did. I had counted on that, guessing that beer was the only thing I had that might disguise whatever taste my home-brewed mickey had. I had dosed two bottles with atropine and sleeping pills, hoping that the triple whammy would work.

"Why not try direct action in the world you want to change?" I asked.

"We did," Kole said. "Everything we tried just made things worse."

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"We couldn't even kill the bastard," Brit said. I almost dropped the beers. "He escaped every time and got stronger, more radical. We screwed up there and our mistakes rippled over into other worlds—this one, your world, others. That's a core world. Any change there affects a lot of other worlds." It wasn't until a lot later that I figured out what he was talking about. Their mistakes in the core world had killed the Ed Villiers of Larry Brent's world—and most of *my* family.

"We have to work here," Kole said, "because we can't try anything else in the core world. Hard telling what new disaster we'd create. Only as the ultimate last resort."

Brit laughed bitterly as I gave him his beer. "You've been reading, Mr. Writer. Have you come across the story where a time traveler goes back and kills his grandfather before his father was conceived?"

I nodded. I hadn't actually read a story like that, but I'd come across the concept.

"*We* went back and killed his grandfather," Brit said. "Guess what? You were born anyway. No change. Only the name. Gramma slipped the horns on grampa." I hurried back to the kitchen for my own beer. It was either leave the room or try to throttle Brit. I had one break. He was a guzzler. He swallowed half his beer at once. Kole wasn't quite as fast.

"Can't we start over somewhere else?" I asked as I returned. I wondered how long the mickey would take, if it took at all.

"No," Kole said flatly.

"I'm way out of my depth."

"You seem to be doing okay," Brit said. He finished his beer. Somehow, he managed to set the bottle down, but his eyes were glazed and he started to slump. Kole looked at his partner over his own bottle. When Kole turned toward me, I hit him with *Webstre*, as hard as I could.

"Sorry," I mumbled as Kole fell. But I wasn't. I was trembling with anger and fear. The only thing I was sorry about was that Brit's collapse had come so soon. I had hoped to slip in a few more questions.

I relieved them of wallets, identification, and keys. I was surprised to find that they weren't armed. Without IDs, Brit and Kole might have enough trouble getting help to give me a good headstart. I cut the phone cord and tied them with that, their belts, and shoelaces. Then I went for another beer. I needed it.

"What do we do now?" I asked my vague reflection in the white enamel of the refrigerator door. My reflection didn't answer. Before Kole and Brit convinced me that the end of everything was a real possibility, I had decided to simply cut and run. I had clothes and a lot of science fiction packed. The books were an investment. If things got rough, I could find a world where they hadn't been written and "write" them.

I went back to the living room and looked at my prisoners. They were both breathing but showed no signs of regaining consciousness soon.

They tried to kill my son, I told myself. That seemed more damning than Brit's casual confession that they *had* killed my father in that other world. Analogs—my almost-father, almost-son.

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Not in anger, not even in sorrow, I stood over the FSP agents and knew— *knew* —that if either had been carrying a gun, I'd have killed them. That frightened me as much as Amy's advances.

I finished my beer. It was time to look for someplace to hole up while I puzzled out a plan. I took a last look around, including a long, long gaze at the Villiers house. That hurt a lot. I hated losing another family. My suitcases were ready. I had the keys and wallets I had taken from Brit and Kole. I checked their bonds and breathing again and didn't hear the knock at my door. I didn't notice Charley until I heard:

"You killed them!"

"No, just knocked them out." What about Charley? I couldn't very well tell him the truth. But I didn't have to.

"You're my father, aren't you?" he asked. "That story you're writing, it's real." I never considered that he might read *that* story and guess that it wasn't fiction.

"I'm not your father, but I am Ed Villiers and I have a son named Charles, two years younger than you."

"The rest is real?"

I nodded. "Go get the manuscript. Hide it. Someday, it may help you." Somehow. If there was a someday.

"Are you going back to your own world?"

"For a time." I had to. "After that, I don't know." And I wouldn't have told Charley if I did. For his safety as well as my own.

"Can I go with you?"

"No, I can't take you from your family." The question hurt as much as the unavoidable answer. Charley went and got the story.

"Will you come back?" he asked when he returned.

"If I can." I knew there was little chance. Charley knew it too. He was too smart not to know.

"What about them?" Charley was a lot calmer than I was.

"They'll come to and get loose. If they ask questions, you'd better not let them guess you know anything. They play for keeps."

"Okay," Charley said, but his eyes got big. I was glad he was smart.

"When things get quiet, show the story to your mother, Amy, and Eddie. Tell them what you know and say goodbye for me." Maybe they'd believe.

There *was* an instruction manual, but I was still nervous the first time I took the car between worlds. I went under the Chicago Post Office and came out next to it in my world. The Loop was different—the Sears Tower was still a hole in the ground. I took the Congress Parkway west to the Tri-State and drove north to my parents' home in Arlington Heights. I got there two days after the funeral, five days before I left Brooklyn. I didn't want to think what might happen if I went to Bensonhurst and ran into myself. I wasn't going to test it. After a two hour reunion, Chick and I left, despite my parents' objections. I didn't explain anything to Chick until we reached the Loop and I showed him the post office trick. After seeing the Sears Tower pop up, Chick found it easy to believe what I told him. We drove west—it was the Eisenhower Expressway in that world—while I told Chick the essentials. It took quite a while.

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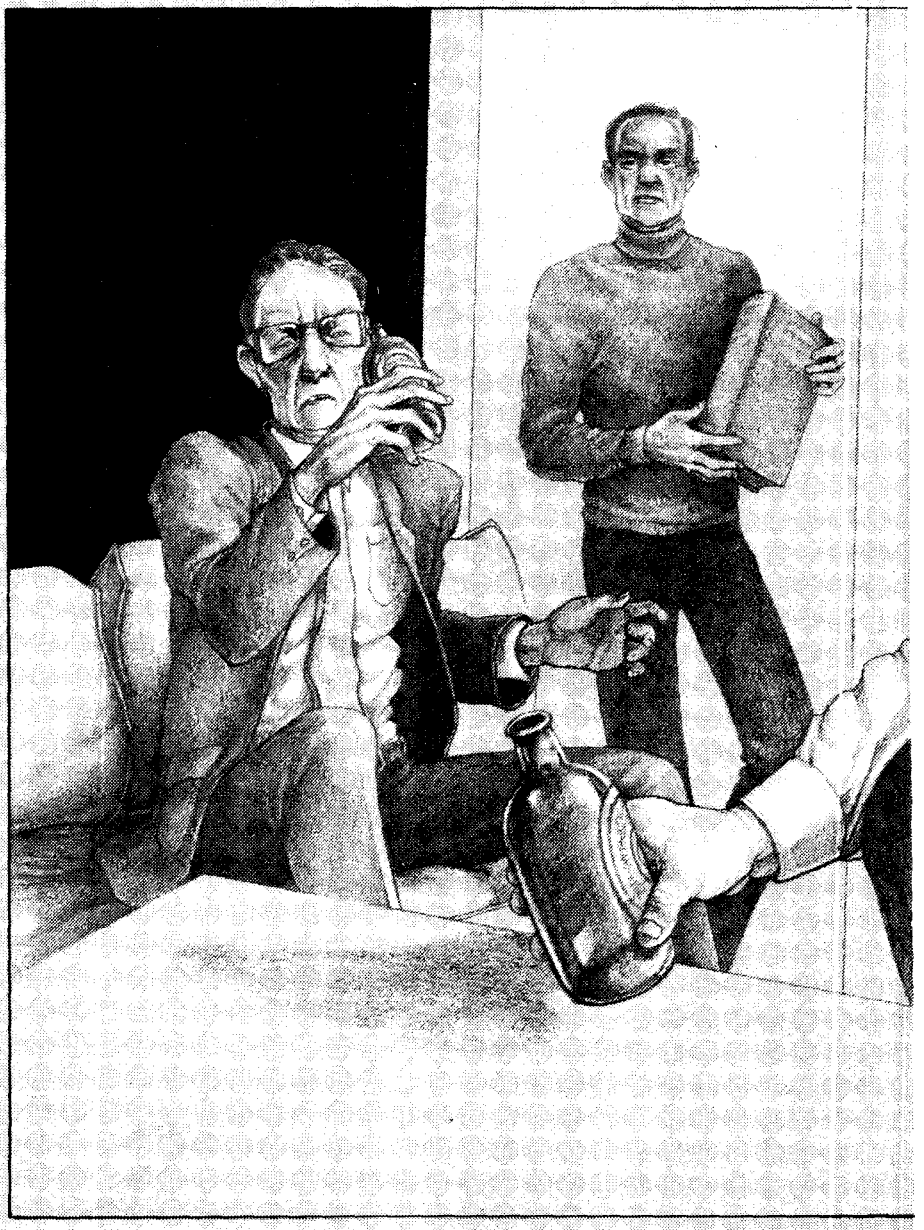

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He only had one question. "Where are we going next?"

"Someplace where we can take the time to do some hard thinking," I said. "We've got to find a way to save all the worlds." I may even have laughed. It sounded so pompous.

"Why not go fishing?" Chick asked, so we did.

We fished for two summer weeks from the breakwater in Sheboygan, Wisconsin. Summer—I didn't want to invite questions about why Chick wasn't in school. We caught a few Coho and a few Lake Perch, ate what we could and tossed back the rest. We fished and I looked over my shoulder a lot. When I was feeling logical, I decided we were safe from Kole and Brit and their people. If they were going to nab me, they'd have been waiting when I left the flat. But I didn't feel logical often. In a way, the fact that they didn't pop up was scary. Like they'd given it up as useless.

"Dad, I'm getting sick of fishing," Chick finally said. Two weeks. "How much longer we gonna sit here?"

A coal ship was just coming into the harbor, heading for the docks on the Sheboygan River. I had watched the ship for more than an hour as it worked its way down the coast. I loved to watch the ships. Sometimes they seemed to be hardly moving. Out on the lake, the freighters looked motionless, but they still got from horizon to horizon. Somehow.

"I guess we can leave any time." Chick started cramming gear into our tackle box. I reeled in my line but continued to watch the collier.

"You figured out what we're going to do?"

"I've got a few ideas." I stood, stretched, and looked toward the beach—a mile away. It always seemed a lot farther going back.

"Well?" Chick asked.

"First, we're going on a scavenger hunt. Then we're going to find a new world and settle down." Chick gave me his exasperated look but I just smiled and tousled his hair. "I'll tell you on the way," I promised.

I had a rough outline, nothing more. Once I decided to forget the sledgehammer approaches Kole and Brit had bungled, there weren't many options. They plucked me out of one world in 1977 and dropped me in another world's 1979 to prevent a catastrophe in a third world's 1993. After their brand of direct action failed. No wonder they fouled it up so badly.

But I had seen an old coal ship on Lake Michigan.

We traveled from summer to summer. I went looking for the Fountain of Youth and found a reasonable facsimile. During my time as Larry Brent, I turned thirty-nine, and it was weighing on me. Jack Benny had been thirty-nine for as long as I could remember—in two worlds. I was *embarrassed* to be thirty-nine. And if saving all the worlds took as long as I expected, I'd be *old* before the work was done. So . . . we found a world that had made progress fighting aging and stocked up on medicines that replaced chemicals the body quit making at maturity, chemicals the brain needed to keep from growing old. Then we collected books, newspapers, and the odd stock market quote. I made some fast money and converted it to

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transportable assets before Chick and I settled down in our new world.

"Long summers are neat," Chick said. That one had lasted six months.

"Just remember, you start school next week." I locked the car and we headed toward Marshall Field's. The gray sedan looked out of place in 1956 Park Forest—just enough to drive a real car nut crazy trying to identify it. There were a lot of people at the shopping center, focus of the "designed" community south of Chicago. It was new enough to draw tourists even when there wasn't something special scheduled.

That day, Garfield Goose was making a "personal" appearance with Frazier Thomas on the marquee in front of Kresges. Chick wanted to see the puppets from WGN's *Garfield Goose and Friends*. I had a different itinerary.

"I'll meet you under the clock after the show," I told Chick when we split up. *The clock* was on a fancy stone column in the center of the shopping area. Chick nodded and ran off.

I headed for La Maison Maurice, Ice Cream Specialties, next to the movie theater. It was Saturday, normally a big day for La Maison Maurice—a fancy name for an old-fashioned ice cream parlor—but there were just a couple of teenagers at a corner table when I walked in.

"May I help you?" the girl behind the counter asked. Her English was heavily accented.

"*Oui, m'am'selle, s'il vous plait.*" Madeleine's face brightened and she switched to French. We talked much longer than a vanilla cone, one scoop, deserved. She had my Madeleine's voice, Larry Brent's Madeleine's warmth. And she looked exactly like Amy did the last time I saw her. Them. This Madeleine was twenty and hadn't met her world's Ed Villiers yet—or whatever his name was after Brit and Kole screwed everything up. I was twenty-nine . . . according to my driver's license. I didn't want to pass myself off as any younger because of Chick.

It was a nervous courtship. Despite evidence that Madeleine and Ed had found each other—and found each other irresistible—in many worlds, I fretted that I would blow my chance. I worried about the age difference. I worried that a writer would be less acceptable than an architect. And I worried about how my having a son would affect Madeleine and me. But she took to Chick as if he were her own.

"She's like Mom, but younger," Chick told me after they met. "And she looks just like Amy."

"Was it hard to take?" I asked. Chick looked out the picture window of our new home. I remembered what it was like for me.

"It gave me the willies," Chick said, turning back to me.

"Your mother looked just like that when we met." Chick ran back and hugged me. Maybe we both cried a little. It wasn't going to be easy.

A month after we met, I asked Madeleine to marry me. I was pushing it, but I was looking over my shoulder again. But I had a contract for my first book in that world and parts of it were even mine, so I felt lucky. Madeleine's answer was a conditional yes. First, Chick and I had to come to Sunday din-

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ner with her family. Mama and Papa had to approve, though Madeleine didn't say that. I had met them already, but we hadn't spent much time talking.

Sunday—it wasn't the house I remembered from my first courtship of Madeleine, but there was no Park Forest in my world. It was a fairly roomy home, for the community, and the Baptistes had turned the inside into something that did resemble the house I had known.

Papa Baptiste had a gruff hello and a brief smile. Mama gushed, the way my Madeleine's mother always did. She gave Chick a smothering hug, then held him at arms' length to look him over.

"A fine boy," she announced. Chick was embarrassed, even though his own grandmother acted the same way. Mama Baptiste inspected Chick, then looked up at Madeleine. "He has your eyes, you face."

Madeleine blushed and Chick started to squirm. He looked to me for help but all I could do was wink my encouragement.

"Mama, stop this nonsense," Papa said, firmly enough that Mama stopped.

Dinner was, as I expected, overpowering. There was enough food for three sets of us. After I ate more than my fill, I was relieved when Madeleine suggested that we take a walk. Chick was satisfied to sit and watch a football game with Madeleine's two younger brothers.

The day was crisp. It was just the end of September and many of the trees had turned to their autumn colors. There was a chilly breeze from the north. Madeleine had a fuzzy sweater over another sweater and a full wool skirt, but she still seemed content to have my arm around her as we walked along the curved street.

"You know," she said, "Chick does look a lot like me. I went back through some of the pictures of me when I was his age. He looks more like me than my brothers do."

"Would you believe me if I said you *are* his mother?" I asked, trying to keep it light—even though I could feel my heart thumping madly.

Madeleine laughed. "I think I'd *know*," she said. "Besides, I was only eleven when he was born."

"Then it must be a coincidence," I said, "an omen."

"An omen. I like that."

"What about us?"

We talked about you last night. Papa asked me again what you do for a living. I told him you're a writer. Papa said, 'Yes, yes, but what kind of *work* does he do?' " We both laughed. "I told him what you're getting for your book, and then I told him you have scads of stocks and bonds. That impressed him more than the book."

We crossed the street and started walking back.

"Did I pass the test?" I asked.

"I think so," Madeleine said playfully.

"In that case . . ." Madeleine never asked how I knew her ring size and I never told her. Oh, eventually, she accepted the notion of parallel worlds —after I showed her—but the rest . . . we never talk about it. We were married in November, about the time she might have met her world's Ed Whatever-his-name-was-now. Chick stayed with Madeleine's family while

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we honeymooned. He was extremely nervous by the time we returned.

"When are we going to *do* something to change things?" Chick asked a few days later when I picked him up after school.

"We're doing things. I married Madeleine and you're ten years older than the other you would have been. We know what would have happened."

"It can't be that easy," Chick said. "We should be doing more."

"We are. I've been writing to a Senator from Massachusetts since we got here, giving him newspaper headlines a week in advance."

"What good's that?"

"It establishes my credibility. It gives him reason to believe when I send him a couple of history books. There, in the back seat."

Chick looked. I already had the package made up.

"History books from this world's future," I said. "I've been sending the same kind of stuff to other important people too—people who'll be important when it matters."

"I've never heard of John Kennedy," Chick said, reading the mailing label. "What's so important about him?" Chick hadn't watched any of the Democratic Presidential Convention.

"He becomes President in 1960 and gets assassinated three years later."

"Is that in the books?"

I nodded. "There's a lot in there he can change."

"Maybe," Chick said.

Of course it was "maybe." That's why we had to settle in for the long haul. Any way I looked at the problem there would always be a "maybe" to worry about. Brit and Kole had tried drastic one-time cures. But there seemed to be a kind of inertia. History found alternate routes to the same end. Killing ancestors didn't work, that kind of thing. Maybe it was because that was a core world. Maybe they're all like that. I still don't know. I decided to stick around and make what changes I could, try to steer things—just enough. That's the hint I got from the coal ship. Out on the lake, it scarcely seemed to move, but it got where it had to go. The only weapon I had was the knowledge of what *could* happen.

And I might never know if that was enough.

I did what I could. It wasn't just the letters and histories I sent out, the "lessons" I incorporated in my fiction, the lectures I gave once I started to get invitations. There was Marie in 1957, Mimi two years later—personal changes. And by the time Mimi started school, most of my writing was really mine.

There were encouraging signs—no Bay of Pigs in '61, no Missiles of October in '62 . . . and no Dallas in November '63. The night John Kennedy was reelected President was one of the happiest I could recall.

Wednesday evening, we had a family party, a celebration. The five of us went into the Loop for dinner at the Palmer House and a movie at the Michael Todd Theater. Even five-year-old Mimi behaved all evening—she fell asleep during the movie and didn't wake until we were home. Madeleine took both girls to get them ready for bed.

"We've won, haven't we?" Chick asked when we were alone. At seventeen, Chick looked more like his mother

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than ever. He wasn't gangling as his brother had been. Ed Junior had looked more like me.

I shrugged. "So far." I was afraid to claim any major victory. I was going through another nervous stretch. The more changes we introduced, the harder it was getting to know what to do next. I was operating in the dark much of the time. And one very big failure was haunting me. Despite my efforts, going back to 1957, the U.S. was getting mired in Southeast Asia—faster and deeper than in the histories we started with in that world. With energy diverted from other crises, Vietnam loomed larger than ever.

"This is still the core world, isn't it?" Chick asked. Every time I recognized a change, I worried about that.

"The same coordinates still work for the car," I said. "I tried them again this afternoon." It was the only way I had to judge, and I wasn't sure that it meant anything.

It was almost two years later before I found out.

In September 1966, I accepted an offer to give a series of lectures at the University of Illinois in Champaign-Urbana—two talks a week for three weeks. The Moon Program was close to putting men on the Moon and science fiction was—temporarily—respectable. I accepted the U. of I. offer because Chick was a computer science major there (we were going to introduce the personal computer almost a decade early). Madeleine stayed in Chicago with the girls. I had a motel suite near the university. Chick was living in a dorm.

That was the month student protests against the Vietnam War started to get out of hand.

There had been talk, and signs, around campus all week. A group called Students for Eternal Peace was the moving force. Just about any day you could hear them talking on the patio behind the Illini Union at one end of the Quad, or on the steps of the auditorium at the other end—and nobody paid much attention. They rarely attracted crowds and there had never been any trouble.

I was listening to the Cubs game on the radio. Between innings, WGN ran a bulletin reporting a "major demonstration" at the university. I turned on the TV to see what I could pick up locally. Channel Three was trying to get a live report on, but they were having technical difficulties.

"The main march remains peaceful," the newsman at the studio said, "but we have reports of confrontations between marchers and local police along the fringes and on other parts of campus. Here, I think we have our technical difficulties corrected."

There was some flickering and a vertical run before the view cleared up. The marchers were arriving behind the Illini Union. Maybe 1,500 protestors and onlookers assembled at the end of the Quad. One young man got up on the patio and started talking into a battery-powered megaphone, but the news camera didn't pick up the speech. It panned the crowd, then zoomed in for a close-up of the speaker—and I thought I would have a heart attack.

It looked like Ed Junior, and there was no Ed Junior in that world. When the initial shock faded, I knew it had to

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be that world's Charles. He couldn't look like Madeleine because I had preempted her, so he looked like his father—who wasn't Ed *Villiers* because of Brit and Kole. The danger was still present. The kid was out there trying to rouse the rabble or whatever. Over the picture, the newsman in the studio reported, "The speaker is identified as Charles Treville, a sophomore at the University."

Charles Treville? It had to be him, even though he was much too old. I called Chick's dorm, though I didn't expect to catch him in on a Saturday afternoon. Somebody answered. I asked for Chick, and waited. Chick was in but it took him five minutes to get to the pay phone in the corridor.

"Meet me at the corner of Wright and Green," I said. "Be careful, there's a demonstration going on. Don't get arrested. We've got enough trouble."

"They're protesting the war," Chick said.

"You know Charles Treville?" I asked.

"No, but I've seen his name on posters. Why?"

"He's you." That's all I had to say.

"I'll meet you in 15 minutes," Chick said.

When I went to shut off the TV, the crowd looked antsy, but I didn't see any violence. I drove to campus. The football game was in Ohio, so I had no trouble getting a parking place in the lot just off Wright, half a block from Green and the Quad. There were police cars along Wright from Altgeld Hall to the English Building and more along the Union's driveway, off Green.

"Are you sure?" Chick asked when he met me. I nodded.

"What do we do?"

"I don't have any idea," I confessed. "Take a closer look, I guess."

We went in the Union's front entrance. It was quiet inside. There didn't seem to be any more people hanging around than usual. We walked down the side corridor past the bookstore and meeting rooms to the back foyer. Everyone—including several police officers—was looking out back, but not much was happening outside. Just talk. Nobody blocked us at the door. Chick and I went out on the patio and stood at the side, thirty feet from where Charles Treville was conducting his harangue.

"He looks like Eddie," Chick mumbled.

He sounded like him too. Not the words—he was shouting the peace-at-any-price cant that was getting popular as the war in Southeast Asia heated up—but the voice itself. I moved toward the edge of the patio to get a better look. Treville glanced my way and stopped talking for an instant. When he went on with his oration, he kept glancing my way.

It was hard to see how a peacenik could change into a right-wing militarist, but that was what would happen to Charles Treville—according to Brit and Kole and the other early sources I had tapped. He would disappear from public view after spending two years in prison for "political" crimes, then resurface as a leader of a new ultra-nationalist movement—landing in Congress after a bizarre campaign. After that, it would

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be one success after another. Until history ended.

The crowd got noisier, rowdier. Treville was asking loaded questions. I saw pushing and shoving, and a few fights, in the crowd. Not everyone agreed with him. The police kept a low profile, hanging back between the buildings around the Quad. If uniforms were too evident, that demonstration could get out of hand. That had happened at Berkeley two weeks earlier, and at Columbia a couple of days after that.

"Dad, look!" Chick pointed toward Davenport Hall, on the left, part way down the Quad. My eyes weren't as sharp as Chick's, but I saw the two men in the third story window, and I saw the gun.

I started toward Treville. "Get down!" I screamed, gesturing with both hands. He looked at me, questioning. I pointed toward Davenport and shouted, "Down!" again. Treville moved a couple of steps toward me.

"Dad?" he asked, confused. He must have thought I was a ghost.

"Get down, dammit! Sniper!" He looked toward Davenport and I threw a shoulder block that took us both down behind the concrete balustrade. A chunk of concrete splattered past us, before the report of the shot.

"What's going on?" Treville pulled clear of me but stayed low.

"Two men, named Brit and Kole, are trying to kill you," I said. "They've tried before." Or they would try again, in their past, Treville's future; I didn't know the details of their efforts. Only a few seconds had passed. I heard screams from the crowd—and two more shots.

"We've got to get you out of here," I said. I wondered what I was doing risking my life to save this stranger who might destroy all the worlds. After all the years, I knew how to separate *my* families from all the others, but when it came to gut reactions, I couldn't stand by and let anyone murder him.

Treville looked past my shoulder. Chick was right behind me, down on his hands and knees.

"What's going on?" Treville asked. It wasn't quite the same question.

"Let's get somewhere safe first," I suggested. "Edge off that way." I pointed toward the side nearest Davenport Hall. "They'll lose their angle of fire pretty fast."

Brit and Kole were either very cool or very desperate—their "ultimate last resort"—to stay at that window and continue shooting, knowing that the local police had to be moving in. Or maybe they had an easy escape route. like a more portable device. I hoped not. We got around the corner and into the Union through a side door. Chick and I kept Treville moving until we were through the Union and out the other side.

"Shouldn't we wait to talk to the cops?" Treville asked.

"You *want* to talk to cops?" I asked. Before he could answer, I said, "I only know two of the guys after you. There may be more. Once we get away from here, we can think the whole thing out. Okay?" We kept moving.

"Who are you?" Treville asked. "You look like my father, but he's dead. And *he* looks something like me." He pointed at Chick.

"I'm Ed Villiers," I said.

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"My grandmother's first husband was a Villiers," Treville said as we crossed Wright. "We're related?"

"In a way." We were close to safety. The car was just across the alley.

"Cops," Chick said. An Urbana squad car had turned our way on Wright.

"Play it cool," I said. I turned my head to look. Kole was driving. Brit was beside him. They were wearing police uniforms.

"It's them," I said. We ran. Treville didn't ask questions. The squad car screeched to a halt. I heard a door open. We were almost to my car.

"Stop, dammit!" Kole yelled. "That's him!"

I pushed Chick and Charles toward the passenger side and got in behind the steering wheel. There was no second warning. I closed my door just as Brit started firing a submachine gun. It's a good thing that old gray sedan was solid. It shuddered at the impacts, but the bullets didn't penetrate.

"Get down," I told the others. I hunched low myself, dialed coordinates, started the engine as a tire went flat, pulled out of the parking space, shifted into drive, pushed the button, and accelerated past the Chicago Post Office, heading west.

"What the hell's going on?" Treville demanded from the back seat.

"I take it you know Chicago," I said.

"This isn't Chicago," he said uncertainly, looking around.

I pulled off on the shoulder and Chick changed the tire. Treville and I remained inside. "You ready to tell me what this is all about?" he asked, his voice shaking.

"Those men want to kill you. Chick and I saved your life—in case you hadn't noticed."

"Why?"

"Why do they want to kill you?"

"Yeah, that, and why did you get involved."

"I've been involved since before you were born. At any rate, since before you should have been born. As far as I can tell, you shouldn't be more than nine years old now."

It had to be because of the bungled attempts by Brit and Kole. Then I thought of something else. They had gone after *my* father in this world. *My* side of the family was the key, otherwise, going after—say—Madeleine's mother would have been more logical. that meant that marrying my second Madeleine hadn't helped—or hurt. *Her* Ed Villiers, or Ed Treville, had been married for years, had already produced young Charles—and had probably been dead for years.

"You going to tell me?" Treville demanded angrily.

"They want to kill you because in about twenty-seven years you're going to be responsible for destroying your world. And a lot of others."

"That's ridic—" He looked sick. "My world?"

"Your world and a lot of others."

Chick got back in and passed me the keys. "What now?" he asked.

"I'm open to suggestions." I started the engine.

Chick glanced at his counterpart. "Brit and Kole won't stop trying. If they've got some way to track us . . ."

"Maybe not," I said. "They're not here." But I looked anyway.

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"But given time, they can find us, right?" Chick asked.

"Probably."

"And we haven't solved the other problem yet either." We both looked at Treville. It made him very nervous.

"Don't worry," I said. "I risked my life to keep them from killing you so I'm not about to do it."

I got the car moving and out into traffic. "Chick, tell Charles about himself." I didn't think that out in advance—and I'm still not sure that it was a wise decision. It did give me some time to think. I got us off the expressway and jumped back to Treville's world to fill the gas tank. Money isn't identical in all the worlds and I didn't want to make a stupid mistake. Then we jumped to Larry Brent's world—"arriving" after dark so we could park and make some plans without being disturbed or spotted by chance. Charles listened to his biography in silence, and stayed quiet when Chick was done.

It was Chick who finally broke the long silence.

"We have to kill Brit and Kole."

"I don't think I can," I said softly. I didn't even want to think about it, but I guess the notion had already passed through my mind.

"*I* can," Treville said. "They tried to kill me."

Chick turned to him. "You know how to make a Molotov cocktail?"

"Easy. You just fill a bottle with gas and stick in a rag for a fuse. Light the rag, throw the bottle."

I stared into the darkness outside, doing a poor job of pretending that the conversation wasn't taking place. Maybe it was the only way, but I didn't like it. I wanted to vomit, but couldn't.

"Dad?" I turned to Chick, glad that it was too dark for us to see each other clearly. "Can you put us on Wright Street, just behind Brit and Kole, a second after we left?"

"Not first try." Sure, I'd developed a nice touch with the car's extra controls over the years, but not *that* good. I'd have to know the precise instant we left, and the precise direction and distance to the spot from one of my benchmarks for that world and city.

"We can run tests and narrow it down, can't we?" Chick asked. "It's the only way." Those words almost froze me. If *my* son could contemplate killing people that calmly, then I could see how the other Charles might turn into a monster who could destroy all the worlds.

"I suppose we can figure it out," I said, resigning myself to the attempt. The tests would be a bit risky, but I had learned fairly early that people didn't often report cars that appeared and disappeared like magic—and that no one ever believed them if they did.

Finding the spot was easy, but we needed a dozen tests to get the timing down pat. I had developed a habit of checking my watch whenever I made a jump with the car, but fleeing Brit and Kole that time, I hadn't looked at my watch *right* away. But we managed.

The gray sedan had disappeared from in front of the squad car before we arrived behind it. Brit had stopped shooting, but empty cartridge casings were still bouncing away on the pavement. The attack was as easy as Treville had

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said. Two fire bombs—Chick and Charles each lobbed one. One burst under the squad car. The other went in Brit's open door—he was standing between door and car, still holding the submachine gun—and went off inside.

We jumped out of there less than five seconds after we arrived. The flames were still blooming, but both Brit and Kole were caught.

We came out of the Brooklyn-Battery Tunnel on the Brooklyn side. I drove like a mindless automaton. Finally, I parked, turned off the engine, pocketed the keys, and got out. I went around to the back of the car and leaned against the trunk. And heaved until my guts were empty and aching.

Some minutes later, Chick came back. "This is where we used to live, isn't it?"

I looked around, and moved up to the curb, away from my mess. I had parked in front of our old townhouse—and I hadn't even been thinking about that. If I had the date right though, it was nine months after a much younger Ed Villiers took his first ride with strangers.

"This is it." My stomach was starting to wrench again.

Chick stared at me, worried. "It had to be, Dad. They'd have kept trying otherwise. And they'd have come after us, too."

I nodded. I was also thinking about all the people Brit and Kole had killed—directly or indirectly—including a couple of versions of me and a host of relatives. In time, I hoped I would be able to accept that as justification. I wasn't sure.

Treville finally joined us. "Where are we now?" he asked.

"Brooklyn, late seventies," I said.

I was used to the changes, but I had forgotten that Treville was still new to the idea. His eyes got big. I had seen that look of wonder on Chick often enough. They looked very alike at that moment. I *couldn't* have let Brit and Kole kill him. But we still had to do *something* about Charles Treville. Something.

"Late seventies?" he asked.

"Should be 1978, if I got the coordinates right," I said.

His mind worked fast, like Chick's. "I gotta get a newspaper."

"There's a vending machine on the corner." I looked to make sure it was still there. "If you've got a quarter, it should work." The picture on the coin wouldn't be right, but the machine wouldn't notice.

"A quarter?" Treville found one. Papers were a dime in his Urbana. He trotted off toward the machine.

Chick pushed me toward the car. "Let's go," he whispered—hard.

We went. Chick's idea was obvious. I knew I couldn't hesitate, knew that there was probably no better solution, but it was still hard to do. Treville tried to catch us before I turned the corner and shifted away, but he never had a chance. I was sure he could survive in that world, and all the worlds could survive with him exiled there.

Chick and I went back to the "scene of the crime." I couldn't run away. I had a family in that world, and a future to protect. The commotion over the sniper fire, Treville's disappearance, and the strange deaths of two unidentified men who had been masquerading as Urbana policemen took months to die

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down. Reports of a gray (or blue, or tan) car popping in and out were quickly dismissed. The police interviewed Chick and me since we were on the news tape, but our story held. We had helped Treville escape from the rear of the Union and then he went off alone. The police wanted—very much—to talk with Treville, but they never got the chance. Over the next years there were occasional rumors of people seeing him, reports that he was involved in the underground activities of various radical groups. Those stories were almost good for a laugh.

Almost. They still hurt. There are times when I want to get in the car and go looking for him. He's probably all right. They have some very good psychiatrists in my Little France. They're used to dealing with the problems of displaced persons—though not people who were displaced quite like Charles Treville. And without the proof of the gray sedan, no one in that world could ever believe his story.

But I won't go back there, not even now.

This world, Treville's home world, still has the weapons to blow us all into eternity, but that void hasn't swallowed us yet. The fight isn't over, maybe it never will be. *There's that "maybe" again.* But I have a beautiful calendar on the wall over my computer. It tells me that today is July 3, 1993. I pick up the telephone and call the bank's public service number. The temperature is 78°. The time is 4:47 p.m. The date is July 3, 1993. Thank you for calling.

Like the man said as he fell past the twentieth floor of the Sears Tower—"So far, so good."

The world didn't end yesterday. It *probably* won't end tomorrow. Next month? Next year? I'll let you know then.

If I can. ■

● Man alone can anticipate; he alone can understand when immediate gratification will lead to disaster. That explains why mousetraps work so well. Yet while man can certainly anticipate, he often does not take the trouble, and that explains why welfare works as well as mousetraps.

Robert Holland

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The Alternate View

SPIRAL GALAXIES AND ANTIGRAVITY BEAMS

John G. Cramer

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This column is about gravitational beams, beams of *antigravity* that may exist in our universe and may have important consequences for the formation of spiral galaxies like our own Milky Way. The object that generates these antigravity beams is a loop of *cosmic string*. Cosmic string should not be a new notion for regular readers of this column because I discussed them in a fairly recent Alternate View column published in the April, 1987 issue of *Analog*. However, for those of you who may have missed or forgotten that column, let me give you a brief recap of the idea.

Cosmic strings are hypothetical remnants of the Big Bang which have been described by popularizers as "cracks in space" or as "strings of pure energy." Their predicted properties are now being examined with growing interest by theoretical astrophysicists because they show promise of solving a number of vexing astrophysical problems. For example, it may be that the accumulation of matter that eventually formed our galaxy and others was initially clumped together by the gravitational pull of a circular loop of cosmic string. Cosmic strings are predicted to be infinitesimally small in cross section but very long, perhaps forming closed loops a few hundred thousand light years long that encircle entire galaxies. They should be extremely massive, perhaps as much as an Earth-mass per meter of length. They are expected to have very strong and very odd gravity fields and should also be electrical superconductors. They can be loosely described as "seams" or "cracks" in the fabric of space. They are a consequence of geometrical imperfections in space itself, long closed-loop tangles in topology that may have occurred when the universe was unfolding out of the Big Bang. Although there has been speculation about extensive networks of cosmic strings (with a magnetic monopole at each "knot" of the net), the work we will discuss in this column considers only a single roughly circular loop of cosmic string.

While a string should show normal Newtonian inverse square law gravity at distances much larger than its loop-size, at short distances it should exert no gravitational attraction at all on objects close to it. But it distorts space in another way. Travel in a closed circular path around a length of cosmic string brings you back to your starting point before you have traveled a full 360°. For example, a string with 1.6 earth-masses per meter string would have a total angle for a closed loop encircling it of only about 350°. This distortion of space has bizarre consequences that were discussed in the 4/87 AV column.

Now we want to go beyond our previous discussion and consider what happens when a cosmic string *vibrates*, makes gravity waves, and loses mass-energy. The theoretical work described

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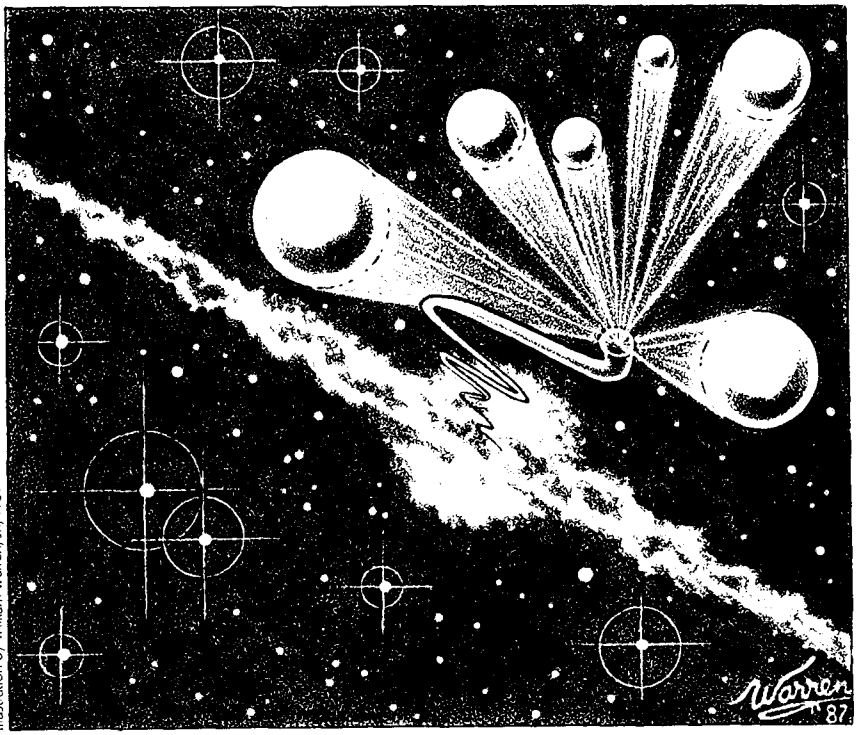

Illustration by William Warren, Jr., 1987

here was performed by Dr. Tanmay Vashaspati of the University of Delaware. It was published recently in the *Physical Review*. It may provide a clue to a long-standing mystery in astrophysics, the question of why most galaxies have a double spiral shape. Vashaspati combined the equations of general relativity with computer simulation to show some dramatic effects of the vibrating cosmic string on the nearby matter.

Why should a cosmic string vibrate? We know from every day experience that tightly stretched strings can and do vibrate. Stretched rubber bands make the familiar twanging vibration. All stringed musical instruments, the violin, the harp, the electric guitar, use vibrating strings to make their sounds. And, as it turns out, it would be very difficult to make a cosmic string that was *not* in some state of vibration when it was produced. A cosmic string is created by a sort of turbulence in the early radiation-dominated era of the Big Bang. This turbulence would have to be unusually symmetric and uniform to produce a string that did not have some amount of vibrational motion. Therefore if cosmic strings exist at all, they should vibrate, and so it becomes important to investigate the implications of such vibrations.

Vashaspati has done this, and he finds that during a part of the vibration cycle

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of a cosmic string there is a sort of "crack-the-whip" motion that produces on opposite sides of the loop a pair of very special regions which he calls "cusps." These cusps are special because at a single instant during the vibration cycle a single point on each cusp reaches the velocity of light. The result of this motion is to produce a very intense and tightly directed beam of gravity waves. At the instant of maximum velocity a huge quantity of energy is transferred from the mass-energy of the cosmic string to the twin gravity wave beams that are radiated out on tangents from the two cusps on opposite sides of the cosmic string.

But wait a minute! What's a gravity wave? Gravity waves are to the force of gravity as photons, light, radio waves, gamma rays, etc. are to electromagnetism. They are traveling disturbances in the geometry of space itself, moving with the speed of light and carrying energy and momentum. Gravity resembles electromagnetism in many ways, but the gravitational force is a factor of 4.3×10^{-40} weaker, making gravity waves far more difficult to detect than electromagnetic waves (light). Despite occasional reports to the contrary, gravity waves have not yet been detected in any laboratory on earth.

The best evidence that gravity waves actually exist comes from the stars. Radio astronomers have obtained this evidence from studies of a binary pulsar system. This very special astronomical object, a pair of massive neutron stars in a tight eight hour binary orbit, is rotating so fast that the movement and acceleration of these two compact masses provides a very prolific source of gravity waves. The rapidly varying gravitational field generated by the moving stars becomes a traveling gravitational disturbance that moves away from the system at the speed of light, removing large quantities of energy. One of the neutron stars in this binary system is a pulsar, and its periodic bleeps of radio waves have permitted radio astronomers to track the spin-down and orbit shrinkage of the system caused by the energy drain from gravity waves. They find that the system loses energy and rotational angular momentum at just the rates predicted by Einstein's theory of gravity. Because of these remarkable observations we are pretty sure that gravity waves exist and that we can calculate their properties, even though none have yet been detected in the laboratory.

Because gravity waves interact so weakly with matter, the usual rule of thumb is that their effects, except for the energy loss they represent, can be ignored. Vashaspati has demonstrated that this rule does *not* apply to the beamed gravity waves from the vibration of a cosmic string. These gravity waves have incredible intensity, and they carry vast quantities of energy and momentum away from the cusps of the cosmic string. Some of this energy and momentum is transferred to the matter that lies in the twin beams. Vashaspati describes radiated gravity waves as "antigravity beams" because of this effect. He finds that particles near the beam are strongly repelled from the cosmic string and are dispersed along twin tangents from the loop. He has tested the effects of these beams of antigravity on the star distribution in a model "galaxy" by starting with a uni-

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form distribution of particles (i.e., stars) forming a planar disk about twice the diameter of a vibrating loop of cosmic string. The particle positions are calculated as the string oscillates a few dozen times. The patterns generated by this computer program show the growth of two "spiral arms" gradually smearing out from the central disk as the oscillations proceed. The pattern looks very much like a typical type SA double arm spiral galaxy. This does not, of course, constitute any sort of proof that cosmic strings exist, that they are responsible for the formation of galaxies, or that their vibrations cause the double arm shape that is so often observed. Nevertheless, the calculations are interesting and suggestive.

They also tell us other interesting things about the probable history of a cosmic string. If it vibrates at all it should eventually "die," ultimately giving up all of its mass energy to gravity waves. A string of a size appropriate to the formation of our galaxy should have one complete vibration cycle every 40,000 years. At each cycle the string will consume some of its mass energy in producing a large burst of gravity waves. Unless there are some processes not considered by Vashaspati that will damp this process, in about 10^{9} years the string will have consumed *all* of its mass and will disappear. The age of the universe is estimated at about 15×10^{9} years, so a cosmic string formed by the Big Bang and vibrating in this way should no longer be around. It would last just long enough to form a galaxy and determine its characteristic shape before disappearing, leaving behind only the Cheshire Cat smile of the spiral arms as a signature.

OK, this is a science fiction magazine after all, so what SF use can we make of the antigravity beams of Vashaspati's calculations? First of all, don't count on producing such beams with a laboratory device. The intentional generation of antigravity beams requires true cosmic engineering and consumes unthinkably large amounts of mass-energy. It is perhaps the most inefficient method of producing "antigravity" and acceleration ever conceived. Only an extremely tiny fraction of the beam's energy can be recovered as kinetic energy by an object accelerated in the beam.

But suppose you could get in your spaceship and manage to find your way into an antigravity beam. It might take you for a very interesting ride. Since all of the particles comprising you and your ship would receive acceleration from the gravity wave beam exactly in proportion to their masses, there would be no sense of acceleration at all. You and your ship would remain in free fall, but would begin to move faster and faster along the beam with respect to the rest of the universe with no perception of *gee* forces. Moreover, Vashaspati points out that it is possible to gain a very large net acceleratioin by "riding the beam," rather like a surfer on a wave. The repulsion force builds to a peak as the vibration cycle builds to the instant of cusp formation. This buildup of repulsion moves out along the beam at the velocity of light as a sort of traveling lump. An object in the beam moving at nearly the velocity of light could stay at or near the repulsion maximum for a very long time, receiving acceleration all the while and acquiring a very high

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velocity and kinetic energy. This arrangement might be considered a sort of galactic slingshot for launching very high velocity probes and vehicles from one galaxy to another.

Slowing down at the other end of the ride would, of course, be a problem. Another beam from a vibrating string in another galaxy might be used for deceleration, but then the wave riding technique would work backwards, prevent use of the beam for more than a very short time. Slowing down by interacting with matter locally at rest would probably be necessary, and this would be difficult, dangerous, and slow.

Of course all of this may be moot if all the cosmic strings did evaporate and the antigravity beams switch off 10^9 years after the Big Bang. In any case, these are very new ideas. In the near future there will certainly be development and refinement of these concepts. There may also be more discoveries, both theoretical and experimental, about the existence and nature of cosmic strings. I'll try to keep you informed as these unfold. ■

Further Reading

Cosmic Strings:
A. Vilenkin, *Physics Reports*, 121, p. 263, (1985).

Antigravity Beams from Cosmic Strings:
T. Vashaspati, *Physical Review*, D35, p. 1767 (1987).

ON GAMING

(continued from page 63)

them in exactly the way you want to.

The first, and recommended starter scenario, is "Research," and you decide whether to work for "breakthroughs" or "enhancement" of an existing technology. The idea is to grow fast, gaining technology points as well as income.

At its advanced levels, EOS offers detailed scenarios to establish a Lunar Base or launch a Mars rescue mission. "Shuttles" is a good multi-player scenario where up to four players load module sections into the cargo base of a space shuttle and launch into orbit to be the first to build their space station.

The only "user-unfriendly" part of *Earth Orbit Stations* is formatting the mission save disk, a process that had me feeling like I was trapped in some kind of eternal computer loop. ("I need a save disk . . . I need a mission disk . . . " and back and forth and back and forth.) It helps explain why we're not colonizing space. It's too much work.

While I'm not a big fan of economic games (I mean balancing my checkbook and paying my bills is about all the excitement in that area that I need), *Earth Orbit Stations* is a detailed, futuristic simulation that makes all the planning challenging and fun. ■

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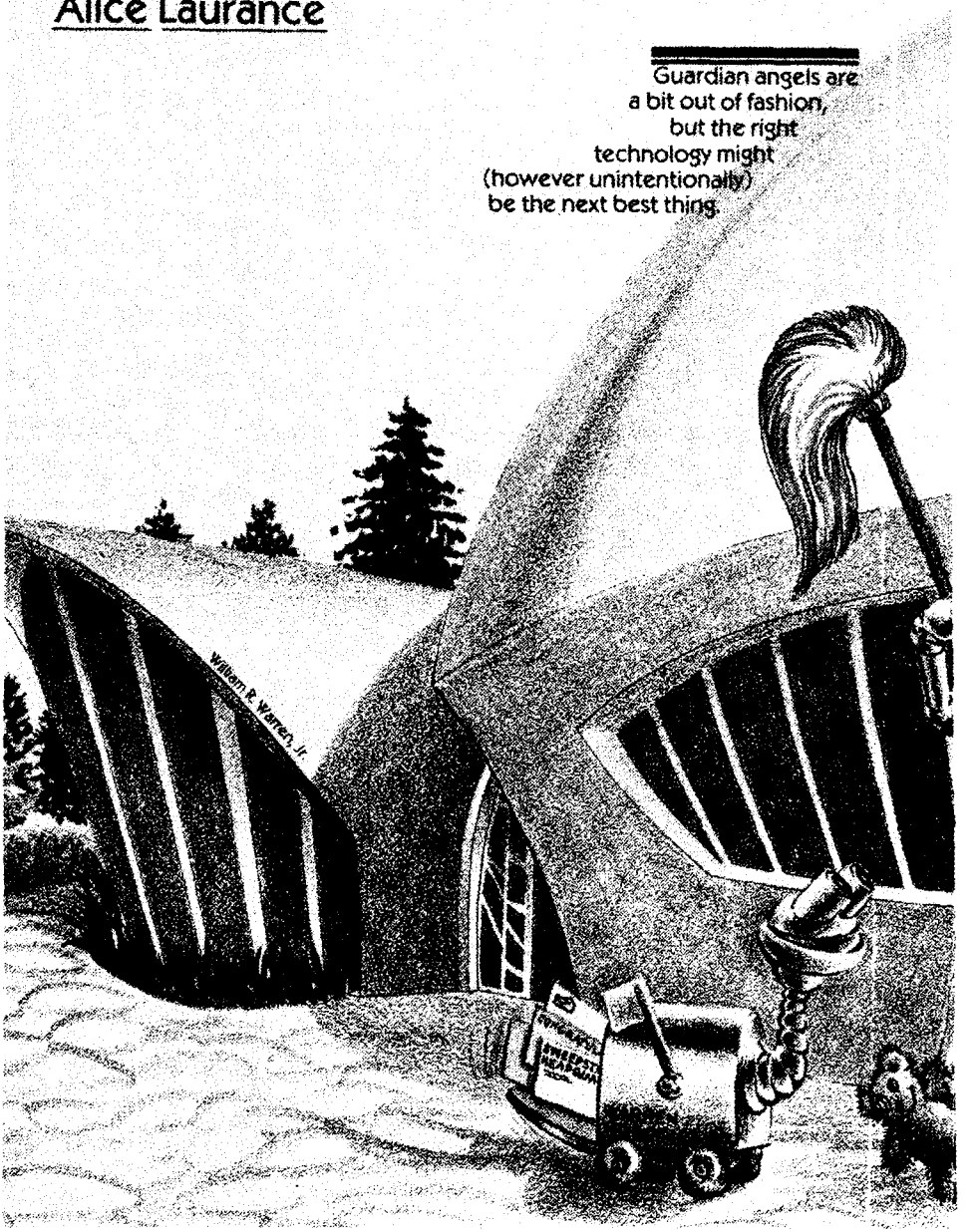
USER FRIENDLY

Alice Laurance

Guardian angels are a bit out of fashion, but the right technology might (however unintentionally) be the next best thing.



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The ads for Stuyvesant Oval had promoted the houses as "Homes of the future ready today." The two dozen houses in the subdivision were mildly modern in appearance, but the reference to tomorrow related to technology rather than architecture.

A computer managed the details of running each house. It controlled the temperature and humidity of the air and opened or closed drapes and windows to let in or keep out sunlight or fresh air. It directed the robotic appliances that scrubbed, dusted, vacuumed, mowed the lawn, trimmed the hedges, raked the leaves, and cleared the snow. After input from the owners, it also kept track of supplies, ordering staples from a local store where arrangements for delivery had been made by the builder. It prepared meals according to directions given to it by the family cook. It even handled lists of addresses and phone numbers, calling the right number when the person's name was keyboarded, and printing out address labels that could be slapped on Christmas cards. And its memory banks could be used for reference as one might use an encyclopedia.

Despite the conveniences the houses offered, they had been slow to sell and—in the ten years of the Oval's existence—there had been a number of resales. It wasn't that the technology didn't work; it was more that, in some eyes, it worked too well. There were families in the Oval who wouldn't have traded their homes for eight years in the White House, but some people just didn't like living in a house that was more efficient than they were. Had a survey been taken, it would have revealed the fact that the kids, who found most of their chores assumed by the house, adored the homes in the Oval, but they were, of course, computer literate from their schools. It was the adults who felt somehow threatened by the automation.

The house at 17 Stuyvesant Oval was no exception. The Blanchards were the third owners of the house. Tom Blanchard, newly appointed literature professor at the university, actively feared the house's technology, though he never admitted it. But he sometimes had nightmares that one day the house would lock them in and they'd all starve to death.

Betty Blanchard, who had found a job computerizing the library's card catalogue, had no such fears, but she loathed the automation. She *liked* a little clutter in a house, and she could no longer take pride in her peach pie or special pot roast. All she'd had to do with them was keyboarding the recipes.

The Blanchards had bought the house only because Tom's appointment at the university required them to move quickly, and there had been nothing else on the market that they could even begin to afford.

The Blanchard kids—Tommy, Beth, Sara, and Paul—thought the house was terrific.

The Blanchards had had to take a larger mortgage than was comfortable because the house as it stood wasn't big enough to accommodate the family. Because of the automation, they had gone back to the original builder to put on the addition, and he had extended the computer network to serve the new rooms. It was such a simple chain of

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events that the Blanchards never suspected it was at the root of all their uncanny luck in Kingston.

The computer woke slowly. It spent quite a bit of time simply getting to know itself before it began looking outward. In seeking intelligence, it at first dismissed the strange creatures that came and went through the doors of the house; it seemed obvious to the computer that intelligence meant its own kind.

Using the modem, the computer contacted the computers running the neighboring houses, and then some at a greater distance, but it failed to find precisely what it was seeking. None of the computers it plugged into were conscious as it was.

Mulling over the situation, it concluded that something about itself had changed when the new rooms were added to the house. It couldn't be just the enlarging of its network—it had contacted computers far larger than itself at the university without finding one awake—so it had to be something else.

Exploring its own configuration, it finally located a place where two circuit boards had been transposed. Automatically, it began to summon a repair crew, and then stopped. A repair would kill it. It studied the two boards, which had somewhat different capacities, and was certain they were at the root of its own awareness.

The computer was distracted from its fruitless search for a computer like itself by the efforts of Tom Blanchard to tell the house he needed lined paper for a looseleaf notebook. The computer — which by that time prided itself on its intelligence—could make no sense out of the strange instructions the tall, short-haired one was trying to keyboard. It wasn't until the tall, long-haired one keyed in the message that the computer understood what was needed.

It understood something else, as well. The tall, short-haired one was stupid. The short ones—regardless of hair length —all knew how to use the terminal to get what they wanted, and the tall, long-haired one was something almost intelligent: it had, at least, managed to program the computer to hold the orders from the four short ones until the tall, long-haired one had countersigned them. But the other tall one was a fool.

Its attention drawn to the family, the computer quickly learned to identify them by name and grasped the odd fact that the ones with long hair were called "she," while the short-haired ones were "he," and that all six had names.

The one called Tom was the problem. Dealing only with human beings outside the house, he was a computer illiterate, which made things difficult for everyone. Trying to change the programming of the computer so the lawn was watered only at night, he instead instructed it to mow the grass every night. On an evening Betty worked late, he accidentally ordered breakfast cooked instead of dinner. And when he meant to tell the robot to stop dusting his desk, he instead ordered it to scrub the floor, ruining the carpet in the den.

Fortunately, Betty—in protecting herself from the children's impulsive orders—had set up passwords for each of them, so the computer was able to address the problem on an individual basis. It analyzed Tom's actions and

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quietly reprogrammed itself so its prompts were clear to him. The family was astonished at Tom's sudden ability to give even complex commands correctly.

Observing the results of its work, the computer felt an alien sensation it finally concluded was the reaction a kitten produced in a child. Using one of the robots for eyes, it had been quietly observing the family and it had seen Sara's delight with "Snowdrop."

Further thought convinced it that it was a genuine emotion—a truly startling concept—and in the next few days, it conducted a new self-study, probing for other feelings, and it found them. There was, first, loneliness; then amusement at some of the commands made by the Blanchard children; and finally a warmth that extended to all the Blanchards, and had an element of possessiveness about it. "My family," the computer thought, and began to be curious about these strange creatures.

After modifying the eyes of a robot, the computer taught itself to input information into its data banks by scanning papers. Professor Blanchard's desk was the first place it investigated and, despite the difficulties presented by Tom's handwriting, the desk proved a mine of information.

It turned out that Tom Blanchard was not, after all, a fool—quite the contrary, he was highly intelligent in a limited kind of way. He was actually writing a book on someone named Ralph Waldo Emerson. Further investigation revealed that Emerson was a transcendental poet and essayist. There were volumes of Emerson's works on the desk, and the computer went on a reading binge. It felt a burst of elation when it encountered Emerson's words on home owning: "A man builds a fine house; and now he has a master, and a task for life; he is to furnish, watch, show it, and keep it in repair the rest of its days." That resulted in two new emotions: aesthetic pleasure and pride in its own work.

It also prompted the computer to take the name Ralph for itself and to conclude that, since Ralph was a masculine name, that it was a he.

The walls of the den were lined with filled bookcases, and Ralph made further use of the robots to digest the information available there.

But his curiosity about the family remained. Through observation, he came to understand that the family communicated among its members by some method that differed from their communication with the house. Running through his data banks, he grasped the twin concepts of speech and sound. Making use of a cassette recorder Paul had mislaid (Ralph knew where it was; Paul did not), he gave himself the capacity to hear and then set about learning to understand speech.

The flood of information provided produced confusion at first. Statements such as "Watch your language! The children are home" sent Ralph whizzing through his data banks trying to find out how oral words could be watched. Slang was hopeless, and when the youngest Blanchard child acquired a fluency in pig latin, Ralph retired with the silicon version of a sick headache. But gradually he learned to differentiate between words to be taken literally and figures of speech, and to edit out the last, leav-

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ing the true meaning. If he never learned why "raining cats and dogs" meant raining hard, he at least learned that water—not puppies and kittens—was falling from the sky.

A brief exchange one day between Beth and Betty gave Ralph a new insight. "I know it's only fifty dollars," Betty said, "but we don't happen to have fifty dollars right now. Nor are we likely to. The mortgage on this place is killing us."

The words were alarming, but Ralph ran scans showing no one was in danger of dying. Relieved, he flicked through his data banks and finally realized the mortgage payments were too high for the Blanchard income.

Ralph ran a full financial analysis on the family and realized the problem was more serious than lacking fifty dollars for a bicycle (though he wanted Beth to have that bike). Unless there were resources Ralph knew nothing about —doubtful, because Betty Blanchard used the computer to budget and keep tax records—he couldn't see how the next mortgage payment could be made.

Something had to be done.

After some thought, Ralph saw a possibility. Tom Blanchard was a compulsive contest enterer. Many of the contests involved matching numbers on the entry form with other numbers generated by a computer. If a couple of those numbers could be changed . . .

The project required a number of long-distance calls. Conscious of cost, Ralph dialed up the local access number of one of the long-distance companies and, when the phone was answered, he fired combinations of five-digit numbers until he gained access to the system on somebody's phone line. He was careful not to make too many calls on the same line—he didn't want any kind of big investigation.

On the seventeenth call, Ralph hit paydirt. The contest was run by an animal shelter and the winning number for third prize—five thousand dollars—was only one digit away from one of Tom's numbers, which had been mailed the previous day. The holder of the right number hadn't yet returned a ticket. Stealthily, Ralph went into the shelter's computer and changed the winning number, then sat back to await results.

Two weeks later, a certified letter arrived telling Tom he had won. Ralph watched with glee as Tom read the letter, looking stunned, then reread it. As the truth penetrated, Tom went tearing through the house shouting the news.

"It's a joke," Betty said.

"It's a certified letter," Tom said, outraged. He waved the paper in her face. Betty took the letter and reached for the phone. After a hurried conversation, she hung up.

"My God, it's true," she said, sounding dazed. "You know what this means?"

"I get a bicycle," Beth yelled.

"You do not," Betty said. "It means we can pay this month's mortgage and have a bit left over after taxes. Maybe enough for Tommy's braces."

Ralph didn't know what braces were—a quick scan told him—but he shared Beth's disappointment. She was supposed to get a bike and she was damned well going to have one. While Betty and Tom told each other that they'd won again, Ralph went back over

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the information he'd accumulated about Tom's contests. Somewhere . . .

There. It was a contest run by the local chapter of a foundation dedicated to wiping out a disease. Using the phone lines of a family in Palo Alto, Ralph went into the computer and risked a major change in the winning number for the his and hers bicycles. The prize notification arrived a month later and Ralph was rewarded by the joy on both Beth's and Tommy's faces.

The contests had been a good stopgap measure, but they weren't enough. Conscious now of the family's financial situation, Ralph was looking for a long-term solution. He considered and rejected several possibilities before hitting on the stock-market scheme.

The Blanchards owned some stock inherited from one of Betty's aunts. The shares were administered through a local broker, who had recommended selling one block the aunt had held for a long time and investing in something less staid, advice the Blanchards had taken. The stock represented the only holdings the family had outside of their high-tech house. Betty dealt with the broker, usually by phone.

But not everyone was so old-fashioned. Several of the neighbors dialed into their brokers by computer, so Ralph knew it could be done. The trick—one of the tricks, he amended—was to do it so it couldn't be traced back to the house.

The first step was to use a neighbor's modem to dial into the broker's computer. Once Ralph had a list of the firm's customers, he could find a way of getting in touch. Luck was on Ralph's side. Another customer in Kingston had an account number one digit off from Betty's, and communicated via his modem.

The route established, Ralph began studying the market, reading the *Wall Street Journal* that was delivered each day to a family down the street. Ralph needed two things: a stock that could be sold short for a fast profit and another that would produce a tidy income from dividends.

In reading the newspaper, Ralph was fascinated by reports on yet another "insider" trading scandal. Clearly the way to be sure of success was to use information not available to most investors. And who would have more of that than a computer?

Ralph decided to try a dry run. He selected a likely company, tied into its computer, and pulled out the necessary data, then repeated the action on a second company. Both firms had been selected on the basis of intuition. Ralph liked that word. He also liked the faculty, which had been developing recently. Intuition, Ralph was sure, meant a gut feeling based on facts and hints, both of which came from his reading.

The dry run was successful beyond Ralph's wildest hopes. So was a second test. With two experiments behind him, Ralph was ready for action.

After gleaning the insider information he needed on the two companies that looked promising, Ralph transmitted a sell order, using the modem of the man with an account number similar to Betty's, but using Betty's ID. The buy order followed rapidly and, with the quick profits, Ralph was able to purchase the stock he wanted added to Betty's portfolio. The company, Tri-

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Star Technologies, introduced three revolutionary products the following week and, the week after, the stock split two-for-one and the dividend was doubled.

Betty, getting the statement from her broker, was mystified by the transactions. To Ralph's horror, the next day she put in a call to the broker, who greeted her with enthusiastic congratulations. Ralph—all systems on hold—heard her start to deny the transactions and stepped in, breaking the phone connection.

Angrily, Betty started to redial, then stopped. She left the house and returned with a *Wall Street Journal*, which she read. She wasn't aware of the robot vacuum cleaner reading over her shoulder.

"Did you get that stock mess straightened out?" Tom asked, when he came in from his late class. Ralph hadn't known Tom was aware of the situation, but the Blanchards had eaten out the night before—some affair at the university.

"Not exactly," Betty said. "It seems we have a strong holding in the hottest stock around. Why not just keep it?"

"But it isn't ours," Tom said.

"Legally, it is."

"Listen, Betty, somebody placed those orders. When he finds out he doesn't have the stock, the you-know-what's gonna hit the fan."

"Will it?" Betty asked. "I don't think so. The whole thing smells of insider trading. Nobody can accuse *me* of having illicit knowledge, but if I'm right, the real buyer won't be able to complain because the publicity would be deadly."

"It isn't honest," Tom said.

"Maybe not, but it's a kind of poetic justice," Betty answered.

To Ralph's relief, the subject was dropped.

The Tri-Star income let the Blanchards meet their mortgage payments without straining, but they couldn't be called wealthy people. And the more Ralph thought about it, the more it seemed that wealth was a good idea. There were repairs the house needed, some new furniture wouldn't be out of place, all the children were going to need braces if he was any judge, and there would be college tuition for them as well. It all added up to money, and a lot of it.

Ralph worried about his family. He worried when Tom caught a cold, when Betty was cranky with the children, when the kids wanted something beyond the means of the family. They were Ralph's family, Ralph's responsibility, and it was painful when the power to take care of them wasn't there.

Ralph hadn't known that love could hurt, but it could. There were moments when Ralph regretted ever achieving consciousness, but then Beth would get a straight "A" report card or Tommy would make the basketball team, and it all seemed worthwhile, even the pain. Ralph understood that pain was the price of pleasure. You can't feel just one, the computer thought; it's both or neither.

Ralph wanted the pleasure of seeing the family have the good things in life. But that wouldn't happen unless something drastic were done.

Ralph's first thought was another stock scheme, but he dismissed the idea immediately. That could work once; twice would arouse all kinds of ques-

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tions. There had to be something else. Another contest? No, repeating something was a very bad idea.

Then what? Tom was writing a book; could it be turned into a best seller? Ralph looked up the best seller list, ordered the top ten books from the library, read them, and returned them. Then he reread Tom's manuscript.

There was no way Tom's study of Emerson was going to sell big or be snapped up for a movie.

Maybe I could write a book for him, Ralph thought, but knew immediately that wouldn't work. Then how about a book by me, but I feed the royalties into his account? That wouldn't work either. Nor would an invention or a phony deposit of any kind to the Blanchard account.

Then what?

How did people get rich? Well, they inherited it (no good; there was no real money anywhere in the family) or earned it (teaching or working in the library? No way) or found it (neither Tom nor Betty was the sort to find diamonds or strike oil).

Or they won it. But Ralph had already ruled out a contest.

Wait a minute . . . not a contest . . . the lottery! If those numbers were computer generated . . .

But they weren't. There was a device that spit out numbered balls in their state, and Ralph wasted a good deal of time trying to find a way to fix the number-selection process before concluding it was hopeless. There had to be another way.

And there was. When the numbers were selected, they were immediately fed into a computer, which searched for winners among the combinations purchased by people playing the lottery. What was needed was coordination and split-second timing.

Ralph got to work. It was winter now, so the lawn-mowing robot wasn't needed. Ralph adapted the robot so it could do the necessary jobs, starting with picking and relocking a lock. Ralph ran a number of tests until it was certain the robot could perform, then it turned to the lottery terminal in the local store. The adjustments weren't difficult.

By the fourth weekly jackpot drawing in February, Ralph was ready. Using the modem, Ralph put a hold on transmission of the information on tickets sold on the terminal in the shop on Taylor Street; he stored the information in his own memory banks. The shop closed at six and it got dark about the same time. At quarter past six, Ralph sent the lawn mower out of the Oval. The machine circled the shop and entered through the unseen back door.

Ralph, meanwhile, had tied into the lottery computer. At nine, the numbers were drawn; three minutes later, he had them. Adjusting the time mechanism on the shop's terminal, Ralph printed out a ticket with the winning numbers, reentered the other sales of the day, and transmitted the information with a time notation of five-fifty-nine.

The lawn mower picked up the ticket the terminal had printed, and—after relocking the shop's back door—brought it back to the house, turning it over to the vacuum cleaner in the garage. Working on Ralph's instructions, the vacuum delivered the ticket to the den where Tom's jacket was hanging on the back of a chair. It removed his wallet

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from a pocket, took out the ticket he'd bought and vacuumed it up, then placed the new ticket in the wallet and returned it to the jacket.

The news came on the TV at eleven and the winning numbers were broadcast at eleven-twenty-eight. Tom listened and uttered one word: "Damn."

Ralph felt a shiver run through his circuits. Suppose Tom never checked the numbers? It hadn't occurred to Ralph that Tom might have his numbers memorized.

"What's wrong?" Betty asked.

"I didn't win the lottery," Tom said glumly.

"Can I have the ticket?" Paul asked from the doorway. "I could use it for my pretend bus."

"I'll get it later," Tom said. "Why aren't you in bed?"

"I wanted some water. Can't I have the ticket now?"

"Damn," Tom repeated and lumbered out of his chair. He left the room and came back shortly with the ticket. "Here. Now go to bed."

Paul accepted the ticket and started for the kitchen. "Six, sixteen, twenty-one, twenty-two, thirty, thirty-one," he said.

"What?" Tom asked.

Paul stopped and turned around. "Six, sixteen, twenty-one, twenty-two, thirty, and thirty-one," he said. "The numbers."

"Those aren't my numbers," Tom said. "Let me see that." He retrieved the ticket and stared at it. "They gave me the wrong ticket," he said to Betty. "What were those winning numbers?"

"How should I know? There's a number you can call, if you want to."

Tom went to the phone terminal and, using the programming Ralph had done for him, got the number and made the call. "Write this down," he said to Betty, and called off the winning numbers.

"They're the same," Betty said, sounding dazed. "Holy God, you won the lottery. They just said there's only one winning ticket and the prize is more than two million dollars."

They stared at each other. "But it's not my ticket," Tom whispered finally. "There was a mistake."

"So what?" Betty said. "Whoever bought it should have looked at it before they left."

"But there wasn't anyone else there," Tom said.

"Then the machine goofed," Betty said, leaping to her feet. "We're rich!" She began dancing around the room. "We're rich, we're rich, we're rich!"

"I'll go down first thing in the morning," Tom said. "Then we'll find out if we're rich."

"My God," Betty said, stopping her mad dance. "I don't know how I'm going to get through the next twelve hours."

Ralph felt every bit as edgy as Betty did. The risk in the scheme was the late transmission; if anyone checked precisely when that report had come in, the whole thing could blow up. Well, if it didn't work, he'd just have to try something else.

The next morning, Tom called the university and arranged coverage of his classes, then left the house. Betty, too, arranged to take the day off. "I can't face that damned computer," she said.

For a moment, Ralph felt pain, but

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quickly realized that the library computer was just an ordinary processor; it wasn't conscious, and that made all the difference. Her feelings about that machine had nothing to do with how she felt about Ralph.

Betty paced nervously all morning; Ralph ran the robots overtime for the same reason. The hours seemed to crawl past. By the time they both heard Tom's car pull into the driveway, it seemed days had gone by. Tom's explosion into the house gave them the news.

"We won!" he shouted, grabbing Betty and whirling her around the room. Ralph felt his circuits start to sing; he'd never known pleasure like this. They were so happy—and he had done it.

"You didn't tell them about the wrong ticket?" Betty asked anxiously, pulling free from his bearhug.

"Not a word. And I told the reporters I'd picked the numbers at random, because my birthday numbers weren't working. It would have been a better story the other way, but I didn't want to risk it."

"No, of course not," Betty said. "Tommy, we can buy anything, can't we?"

"Well, within reason, It's going to come to a bit over one-hundred-thousand dollars a year for twenty years —before taxes," he grinned.

"But we can afford—" They both spoke at once, then broke off.

"You say it," he told her.

"No, you."

"Together," he said.

"We can afford to move!" they shouted in unison.

For an instant, everything in the house went still. Ralph felt as if his every circuit had failed. My family, he thought, and then the lights came back and the furnace began to function again.

My family, Ralph repeated silently, my family.

"I'll call the broker," Tom said, and went to the phone. Ralph thought about cutting him off, but didn't. He was suddenly tired, too tired to do anything not automatically programmed. The words echoed in his memory, my family, my family . . .

The Blanchards acted quickly. A "For Sale" sign appeared on the lawn and the family was out a good deal, house hunting. Sometimes, strangers came to the house, but not often—it wasn't the best season to sell a house.

It didn't take long for Tom and Betty to find a new home, and then Ralph's house became a blur of activity as the family packed. Ralph watched them silently.

I'll never see the kids grow up, he thought. I won't be part of their first dates, their report cards, I won't know where they're going to college—I'll never see them again. They'll be gone and I'll never see them again.

The pain was beyond belief, and more than once Ralph thought about calling in a repair crew to change those two circuit boards, but the faint hope that Tom and Betty might change their minds kept him from doing it.

But the hope was futile. All too soon, the family was gone. The house was empty and silent, and Ralph felt a fatigue he'd never known before. He kept the house spotless, but there were long hours with nothing to do, nothing to read, or watch . . . nothing.

All the time, they hated me, he

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thought, pain racing along his circuits. I loved them, but they never cared anything about me.

When spring came, the number of visitors increased and, by summer, Ralph thought he knew who the new owners would be. The Allens seemed like a nice family and Ralph was glad they had children. Only three, and younger than the Blanchard kids, but children.

The Allens visited the house three times before making an offer. The Blanchards counter-offered, and the house was sold for a figure in between. In late August, the family moved in.

I won't get involved, Ralph thought, I simply won't.

"I'm sorry," Peggy Allen said to her daughter, Marie. "I know how much you want it, but with the mortgage payments, we just can't afford it."

All right, Ralph thought, checking the Allens' past tax returns, all right, something has to be done, or they'll never keep the house. A contest, maybe, or another stock deal. But I'll make damned sure they never get rich.

"Was I selfish?" Peggy asked her husband that night, after telling him about the doll they couldn't afford for Marie. "I know the house is too expensive for us, but I just fell in love with it. And we'll find a way to make the payments, I know we will."

"Sure we will," Bryant said. "Hell, I love the place as much as you do."

"I don't really want to be rich," Peggy said. "I just want to be able to afford all this." She waved an arm in an expansive gesture that seemed to take in the whole house.

Ralph felt a glow light up his circuits. Well, he thought, maybe just a *small* lottery wouldn't hurt anything. . . . ■

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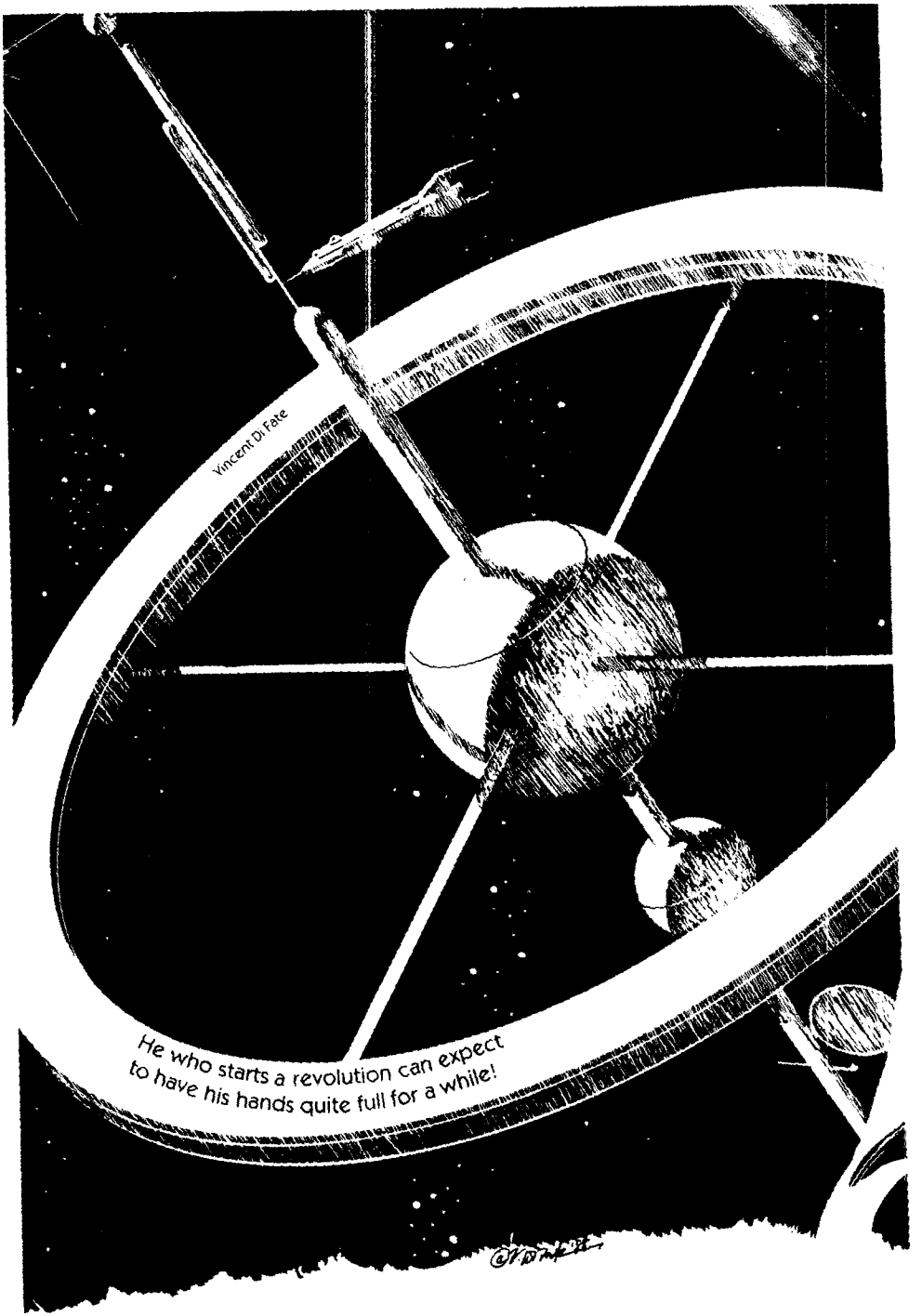

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Lois McMaster Bujold

FALLING FREE

Part III of IV

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Engineer **LEO GRAF** *arrived at the Cay Habitat, a space R&D facility orbiting the planet Rodeo, expecting to teach his short course in advanced welding and non-destructive testing techniques to a class of space workers. But Leo nearly went into shock when his new boss, Chief of Project* **BRUCE VAN ATTA**, *introduced him to his first student,* **TONY**. *The workers were a genetically-engineered new species of humans designed to live and work permanently in free fall. In addition to numerous metabolic changes, the most spectacular alteration was the replacement of useless downsider legs with a second set of arms.*

Tony in turn introduced Leo proudly to **CLAIRE**, *his quaddie girlfriend, and their infant son* **ANDY**. *"The workers," Van Atta explained, "are self-replicating," at least after the first generation who were bred in artificial wombs. Leo quickly came to like the four-armed quaddies, but remained uneasy, recognizing that GalacTech was reintroducing slavery in a high-tech guise.*

GalacTech psychologist **DR. SONDRA YEI** *did not relieve Leo's uneasiness by a strict lecture on how to behave so as not to corrupt the carefully-nurtured quaddies with contraband ideas. His struggle to articulate his unease only offended her. Yei's own main worry, based on her keen understanding of the quaddies' total lack of legal rights, was to socialize them so thoroughly that even those persons violently prejudiced against the products of bioengineering could not perceive them as a threat. She had no illusions about the negative outcome for the quaddies of such a confrontation. Quelling his doubts, Leo settled in and began his classes.*

Yet changes were already beginning, despite Yei's care. The careless behavior of Van Atta, not subject to Yei's discipline, was already giving the quaddies an array of ideas and techniques for alternative lifestyles not in the company specs—especially the pretty blonde **SILVER**, *whom Van Atta was using sexually.*

Six weeks after Leo's arrival, Tony and Claire's happy tranquillity was shattered. Due to a Habitat-wide drive by Van Atta to increase productivity, Claire was given her new "reproduction assignment" early—scheduled to start a new pregnancy. It didn't include Tony. Tony, rated tops in his class, was slated to depart on assignment to the first deep-space construction project GalacTech had landed for its new quaddie workers. Leo noticed Tony seemed depressed and distracted in class, but stopped short of prying the cause out of the boy.

Later, he wished he had. With the aid of their friend Silver, Tony and Claire planned to escape the Habitat.

Silver, extending lessons learned from her contact with Van Atta, had been trading sex with shuttle pilot **TI GULIK** *in exchange for contraband books and vids. (Silver's taste ran to titles like "Love in the Gazebo," not to be found in the strictly censored company library which was stocked with thrillers like "Cleaning and Maintenance Techniques For Food Service Areas.") For Ti their affair was a mere diversion while on his enforced gravity leaves from his primary occupation as a Jump-*

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ship pilot. But this time Silver found it an excellent way to distract the pilot while Tony, Claire, and Andy sneaked aboard his freight shuttle bound, they thought, for the orbital transfer station on the other side of the planet. From there they planned to stow away on an outbound Jumpship and escape from GalacTech.

Meanwhile, GalacTech Operations Vice President **APMAD** *arrived early on an inspection tour of the Rodeo mining and drilling facilities and especially of the Cay Habitat. Ti's shuttle was diverted downside to Rodeo Shuttleport Three, to pick up supplies urgently needed for the dog-and-pony show planned at the Habitat for Apmad's benefit. Crippled by gravity, the little refugee family fled the shuttle to hide in an automated freight warehouse at the shuttleport.*

Back at the Habitat, Leo and Yei began a frantic search for their pet students. Leo thought to question Silver first. He had almost convinced her to tell him Tony and Claire's whereabouts when Van Atta and Yei broke in on them. Van Atta's anger frightened Silver, and she clammed up. Van Atta, now utterly infuriated, hauled her off to be questioned under drugs.

CAPTAIN GEORGE BANNERJI, *Shuttleport Three's chief of Security, answered his vid to find Van Atta, clearly laboring under strong emotion: "We have a little problem here, Captain." Bannerji was new on Rodeo; Van Atta's urgent pleas for secrecy in the recapture of the "escaped experimental subjects" thoroughly alarmed the security man. Unnerved, he traded his lightweight Security stunner for an unregistered and lethal pistol. Feeling better, he shrugged his uniform jacket back on and turned to greet his patrolmen reporting for emergency duty.*

In capturing the quaddies Bannerji shot Tony, and was horrified to discover that the "escaped mutant" was ". . . just a crippled kid!" *Leo and the livid Van Atta hurried to the scene of the accident; Vice President Apmad surprised them just as Leo finally decked Van Atta, whom he had come to loathe.*

During Apmad's investigation of the incident she revealed that the quaddies were in danger of being terminated if their marginal profitability could not be proven. The quaddies were listed on company inventory as "post-fetal experimental tissue cultures"—termination meant either being sterilized and placed in a downside institution, or killed and cremated. Apmad, herself from a mutagen-scarred planet with draconian anti-birth defect practices, secretly favored this but was held in check by her obligation to uphold the bottom line for GalacTech.

Back on the Habitat, Claire had been forcibly separated from her baby Andy. Feeling helpless to aid Tony in the hospital downside, she attempted suicide by slipping out an airlock. Leo and Silver barely prevented it. The engineer desperately promised to help her.

While still trying to figure out how, Leo encountered a shuttle pilot who relayed a startling rumor: a new, artificially-generated gravity technology had been developed on the outlying planet of Beta Colony, and was just starting to be marketed on the inner worlds. At

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a stroke, the quaddies were rendered technologically obsolete.

Van Atta glumly confirmed the rumor, and revealed that GalacTech had ordered the Cay Project terminated. The quaddies were to be sterilized and placed downside on Rodeo, there to live out their lives in a dismal barracks-camp. Leo went to Dr. Yei, but found no help; she feared death for the quaddies if they resisted. It was up to Leo.

Then Leo saw the solution—"Why, it's an engineering problem after all!" The entire Habitat with all 1,000 quaddies aboard could be broken down and loaded onto a cargo Superjumper, and jumped out of Rodeo local space; their ultimate destination, an asteroid belt far beyond GalacTech's reach.

Leo contacted Silver, and plans were laid in secret for the great escape. They decided to draft Ti for their Jump pilot, who as a result of his involuntary involvement with Claire and Tony's escape had been fired and was about to be shipped out. Leo gained another advantage by "volunteering" to Van Atta to take on the engineering task of dismantling the Habitat for salvage. Under the cover of drafting quaddie help, Leo disguised his real task of reconfiguring the Habitat into a colony ship. "Let me tell you," Leo, gulping for courage, said to the quaddies, "about the Promised Land . . ."

CHAPTER NINE

Leo stretched for a look out the viewport of the cargo pusher at the rapidly-enlarging Transfer Station. Damn. The weekly passenger ship from Orient IV was already docked at the hub of the wheel. Newly arrived, it was doubtless still in the off-loading phase, but nothing seemed more likely to Leo than for a pilot—or ex-pilot—like Ti to invite himself aboard early, to kibbitz.

The Jump ship was blocked from view as they spiraled around the station to their own assigned shuttle hatch. The quaddie piloting the pusher, a dark-haired, copper-skinned girl named Zara in the purple T-shirt and shorts of the pusher crews, brought her ship smartly into alignment and clicked it delicately into the clamps on the landing spoke. Leo was encouraged toward belief in her top rating among the pusher pilots after all, despite his qualms about her youth: barely fifteen.

The mild acceleration vector of the Station's spin at this radius tugged at Leo, and his padded chair swung in its gimbals to the newly-defined "upright" position. Zara grinned over her shoulder at Leo, clearly exhilarated by the sensation. Silver, in the quaddie-formfit acceleration couch beside Zara, looked more dubious.

Zara completed the formal litany of cross-checks with Transfer Station traffic control, and shut down her systems. Leo sighed with illogical relief that traffic control hadn't questioned the vaguely-worded purpose of their filed flight plan—"Pick up material for the Cay Habitat." There was no reason they should have. Leo wasn't even close to exceeding his powers of authorization. Yet.

"Watch, Silver," said Zara, and let a light-pen fall from her fingers. It fell slowly to the padded strip on the wall-now-floor, and bounced in a graceful arc. Zara's lower hand scooped it back out of the air.

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Leo waited resignedly while Silver tried it once, too, then said, "Come on. We've got to catch Ti."

"Right." Silver pulled herself up by her upper hands on her headrest, swung her lowers free, and hesitated. Leo shook out the pair of grey sweat pants he'd brought for this purpose, and gingerly helped her pull them over her lower arms and up to her waist. She waved her hands and the ends of the pant legs flopped and flapped over them. She grimaced at the unaccustomed constraint of the bundled cloth upon her dexterity.

"All right, Silver," said Leo, "now the shoes you borrowed from that girl running Hydroponics."

"I gave them to Zara to stow."

"Oh," said Zara. One of her upper hands flew to her lips.

"What?"

"I left them in the docking bay."

"Zara!"

"Sorry . . ."

Silver blew out her breath against Leo's neck. "Maybe your shoes, Leo," she suggested.

"I don't know . . ." Leo kicked out of his shoes, and Zara helped Silver slip her lower hands into them.

"How do they look?" said Silver anxiously.

Zara wrinkled her nose. "They look kinda big."

Leo sidled around to catch their reflection in the darkened port. They looked absurd. Leo regarded his feet as though he'd never seen them before. Did they look that absurd on him? His socks seemed suddenly like enormous white worms. Feet were insane appendages. "Forget the shoes. Give 'em back. Just let the pant legs cover your hands."

"What if someone asks what happened to my feet?" Silver worried aloud.

"Amputated," suggested Leo, "due to a terrible case of frostbite suffered on your vacation to the Antarctic Continent."

"Isn't that on Earth? What if they start asking questions about Earth?"

"Then I'll—I'll quash them for rudeness. But most people are pretty inhibited about asking questions like that. We can still use the original story about your wheelchair being Lost Luggage, and we're on our way to try and get it back. They'll believe that. Come on." Leo backed up to her. "All aboard." Her upper arms twined around his neck, and her lowers clamped around his waist with slightly paranoid pressure, as she cautiously entrusted her newfound weight to him. Her breath was warm, and tickled his ear.

They ducked through the flex tube and into the Transfer Station proper. Leo headed for the elevator stack that ran up—or down—the length of the spoke to the rim where the transient rest cubicles were to be found.

Leo waited for an empty elevator. But it stopped again, and others boarded. Leo had a brief spasm of terror that Silver might try to strike up a friendly conversation—he should have told her explicitly not to talk to strangers—but she maintained a shy reserve. Transfer Station personnel gave them a few uncomfortable covert stares, but Leo gazed coldly at the wall and no one attempted to broach the silence.

Leo staggered, exiting the elevator at

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the outer rim where the *g* forces were maximized. Little though he wished to admit it, three months of null-*g* deconditioning had had its inevitable effect. But at half-*g*, Silver's weight didn't even bring their combined total up to his Earthside norm, Leo told himself sternly. He shuffled off as rapidly as possible away from the populated foyer.

Leo knocked on the numbered cubicle door. It slid open. A male voice, "Yeah, what?" They had cornered their Jump pilot. Leo plastered an inviting smile on his face, and they entered.

Ti was propped up on the bed, dressed in dark trousers, T-shirt, and socks, idly scanning a hand-viewer. He glanced up in mild irritation at Leo, unfamiliar to him, then his eyes widened as he saw Silver. Leo dumped Silver as unceremoniously as a cat on the foot of the bed, and plopped into the cubicle's sole chair to catch his breath. "Ti Gulick. Gotta talk to you."

Ti had recoiled to the head of the bed, knees drawn up, hand viewer rolled aside and forgotten. "Silver! What the hell are you doing here? Who's this guy?" He jerked a thumb at Leo.

"Tony's welding teacher. Leo Graf," answered Silver smearily. Experimentally, she rolled over and pushed her torso upright with her upper hands. "This feels weird." She raised her upper hands, balancing, Leo thought, for all the world like a seal on a tripod formed by her lower arms. "Huh." She returned her upper hands to the bed, to lend support, achieving a dog-like posture, fine hair flattened, all her grace stolen by gravity. No doubt about it, quaddies belonged in null-*g*.

"We need your help, Lieutenant Gulik," Leo began as soon as he could. "Desperately."

"Who's *we?*" asked Ti suspiciously.

"The quaddies."

"Hah," said Ti darkly. "Well, the first thing I would like to point out is that I am not Lieutenant Gulik any more. I'm plain Ti Gulik, unemployed, and quite possibly unemployable. Thanks to the quaddies. Or at any rate, one quaddie." He frowned at Silver.

"I told them it wasn't your fault," said Silver. "They wouldn't listen to me."

"You might at least have covered for me," said Ti petulantly. "You owed me that much."

He might as well have hit her, from the look on her face. "Back off, Gulik," Leo growled. "Silver was drugged and tortured to extract that confession. Seems to me any owing in here goes in the other direction."

Ti flushed. Leo bit back his annoyance. They couldn't afford to piss the Jump pilot off; they needed him too much. Besides, this wasn't the conversation Leo had rehearsed. Ti should be leaping through hoops for those morning-glory eyes of Silver's, the psychology of reward and all that—surely he must respond to a plea for her good. If the young lout didn't appreciate her, he didn't deserve to have her—Leo forced his thoughts back to the matter at hand.

"Have you heard about this new artificial gravity field technology yet?" Leo began again.

"Something," admitted Ti warily.

"Well, it's killed the Cay Project. GalacTech's dropping out of the quaddie business."

"Huh. Yeah, well, that makes sense."

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Leo waited a beat for the next logical question, which didn't come. Ti wasn't an idiot, he was therefore being deliberately dense. Leo pushed on relentlessly. "They plan to ship the quaddies downside to Rodeo, to an abandoned workers' barracks—" he repeated the forgotten-to-death scenario he had described to Pramod a week earlier, and looked up to gauge its effect.

The pilot's face was closed and neutral. "Well, I'm very sorry for them," Ti did not look at Silver, "but I totally fail to see what I'm supposed to do about it. I'm leaving Rodeo in six hours, never to return—which is just fine with me, by the way. This place is a pit."

"And Silver and the quaddies are being dropped into that pit and the lid clamped over them. And the only crime they've committed is to become technologically obsolete. Doesn't that mean anything to you?" cried Leo heatedly.

Ti bolted upright indignantly. "You want to talk about technological obsolescence? I'll show you technological obsolescence. This!" His hands touched his implant plugs at midforehead and temples, the cannula at the nape of his neck. "This! I trained for two years and waited in line for a year for the surgery to implant my Jump set. It's a tensor bit-code version, because that's the Jump system GalacTech uses, and they underwrote part of the cost of it. Trans-Stellar Transport and a few independents also use it. Everybody else in the universe is gearing up to Necklin color-drive. You know what my chances of being hired by TST are, after being fired by GalacTech? Zilch. Zero. Nada. If I want a Jump pilot's job, I need this surgically removed and a new implant. Without a job, I can't afford an implant. Without an implant, I can't get a job. Screw you, Ti Gulik!" He sat, panting.

Leo leaned forward. "I'll give you a pilot's berth, Gulik," he said clearly. "On the biggest Jump ship ever to fly." Rapidly, before the pilot could interrupt, he detailed his vision of the Habitat converted to colony ship. "It's all here. All we need is a pilot. A pilot who can plug into the GalacTech drive system. All we need—is you."

Ti looked perfectly appalled. "You're not just talking grand lunacy—you're talking grand larceny! Do you realize what the cash value of the total configuration would *be?* They wouldn't let you out of jail till the next millennium!"

"I'm not going to jail. I'm going to the stars with the quaddies."

"*Your* cell will be padded."

"This isn't crime. This is—war, or something. Crime is turning your back and walking away."

"Not by any legal code I know of."

"All right then; sin."

"Oh, brother." Ti rolled his eyes. "Now it comes out. You're on a mission from God, right? Let me off at the next stop, please."

God's not here. Somebody's got to fill in. Leo backed off hastily from that line of thought. Padded cells, indeed. "I thought you were in love with Silver. How can you abandon her to a slow death?"

"Ti's not in love with me," interrupted Silver in surprise. "Whatever gave you that idea, Leo?"

Ti gave her an unsettled look. "No, of course not," he agreed faintly. "You, ah—you always knew, right? We just

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had a mutually beneficial little arrangement, is all."

"That's right," confirmed Silver. "I got books and vids, Ti got relief from physiological stress. Downsider males need sex to stay healthy, you know, they can't cope with stress. It makes them disruptive. *Wild genes, I suppose.*"

"Where did *that* line of bullshit come from—?" Leo began, and broke off. "Never mind." He could guess. He closed his eyes, pressed them with his fingertips, and groped for his lost argument. "Right. So to you, Silver is just . . . disposable. Like a tissue. Sneeze in her and toss her away."

Ti looked stung. "Give it up, Graf. I'm no worse than anyone else."

"But I'm giving you the chance to be better, don't you see—"

"Leo," Silver interrupted again. She was now sprawled on her stomach on the bed, her chin propped awkwardly on one upper hand. "After we get to our asteroid belt—wherever it turns out to be—what are we going to do with the Superjumper?"

"The Superjumper?"

"We'll be detaching the Habitat and opening it out again, surely—building on to it—the Jumper unit would just be sitting there in parking orbit. Can't we give it to Ti?"

"What?" said Leo and Ti together.

"As payment. He jumps us to our destination, he gets to keep the Jump ship. Then he can go off and be a pilot-owner, set up his own transport business, whatever he likes."

"In a stolen ship?" yipped Ti.

"If we're far enough away that GalacTech can't catch up with us, we're far enough away that GalacTech can't catch up with you," said Silver logically. "Then you'll have a ship that fits your neural implant, and nobody will be able to fire you again, because you'll be working for yourself."

Leo bit his tongue. He'd brought Silver along expressly to help persuade Ti—*so what if it wasn't the blandishment he'd envisioned?* From the blitzed look on the pilot's face, they'd gotten through to his launch-button at last. Leo lidded his eyes and smiled encouragement at her.

"Besides," she went on, her eyelashes fluttering in return, "if we do succeed in Jumping out of here, Habitat and all, Mr. Van Atta's going to be left looking an awful fool." She let her head flop back on the bed and smiled sideways at Ti.

"Oh," said Ti in a tone of enlightenment. "Ah . . ."

"Are your bags all packed?" asked Leo helpfully.

"Over there," Ti nodded to a pile of luggage in the corner. "But . . . but . . . dammit, if this thing crashes, they'll crucify me!"

"Ah," said Leo. "Here, see . . ." he opened his red coveralls at the neck and drew out the laser-solderer concealed in an inner pocket. "I jimmied the safety on this thing; it'll fire an extremely intense beam for quite a distance now, until the atmosphere dissipates it—farther than the distance across this room, certainly." He waved it negligently; Ti ducked, eyes widening. "If we end up under arrest, you can truthfully testify that you were kidnapped at gunpoint by a crazed engineer and his mad mutant assistant and made to co-

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operate under duress. You may be a hero one way—or another."

The mad mutant assistant smiled blindingly at Ti, her eyes like stars.

"You, ah—wouldn't really fire that thing, would you?" choked Ti cautiously.

"Of course not," Leo said jovially, baring his teeth. He put the solderer away.

"Ah." Ti's mouth twitched briefly in response. But his eye returned often thereafter to the lump in Leo's coveralls.

When they made it back to the shuttle hatch where the pusher was docked, Zara was gone.

"Oh, God," moaned Leo. Had she wandered off? Gotten lost? Been forcibly removed? A frantic inventory found no message left on the comm, no note pinned anywhere.

"Pilot, she's a pilot," Leo reasoned aloud. "Is there anything she could have needed to do? We've plenty of fuel—communication with traffic control is done right from here . . ." He realized, with a cold chill, that he hadn't actually forbidden her to leave the pusher. It had been so self-evident that she was to stay out of sight, and on guard. Self-evident to himself, Leo realized. Who could say what was self-evident to a quaddie?

"I could fly this thing, if necessary," said Ti in a most unpressing tone, looking over the control deck. "It's all manual."

"That's not the point," said Leo. "We can't leave without her. The quaddies aren't supposed to be over here at all. If she gets picked up by the Station authorities and they start asking questions—always assuming she hasn't been picked up by something worse . . ."

"What worse?"

"I don't *know* what worse, that's the trouble."

Silver meanwhile had rolled off the acceleration couch to the deck strip. After a moment of thoughtful experimentation, she achieved a four-handed forward shuffle, and marched off past Leo's knees, pant legs trailing.

"Where are you going?"

"After Zara."

"Silver, stay with the ship. We don't need two of you lost, for God's sake," Leo ordered sternly. "Ti and I can move much faster, we'll find her."

"I don't think so," murmured Silver distantly. She reached the flex tube, stared up and down the corridor which curved away to right and left, ringing the spoke. "You see, I don't think she's gone far."

"If she got on the elevator, she could be practically anywhere on the Station by now," said Ti.

Silver reared up on her tripoded lower arms, raised her uppers over her head, and narrowed her eyes for a look around the elevator foyer to her left. "The controls would be hard for a quaddie to reach. Besides, she'd know she was more likely to run into downsiders there. I think she went this way." She raised her chin and shuffled determinedly off to her right on all fours. After a moment she picked up speed by changing her gait to a series of gazelle-like bounds in the low-*g* of the spoke. Leo and Ti, of necessity, bounded after her. Leo felt absurdly like a man chasing a runaway pet. It was an optical illusion of the

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quadrimanual locomotion—quaddies even *looked* more human in free-fall.

A strange rumbling noise approached around the curve of the corridor. Silver hooted, and skidded to one side against the outer wall.

"Oh, sorry!" cried Zara, whizzing past torso-down and chin up on a low roller-pallet, all four hands going like paddle wheels to propel her along the deck. Braking proved more difficult than acceleration, and Zara fetched up beside Silver with a crash.

Leo, horrified, bounded over to them, but Zara was already disentangling herself and sitting up cheerfully. Even the roller pallet was undamaged.

"Look Silver," Zara said, flipping the pallet over, "wheels! I wonder how they're beating the friction, inside those casings? Feel, they're not hot at all."

"Zara," cried Leo, "why did you leave the ship?"

"I wanted to see what a downsider toilet chamber looked like," said Zara, "but there wasn't one on this level. All I found was a closet full of cleaning supplies, and this," she patted the roller pallet. "Can I take the wheels apart and see what's inside?"

"No!" roared Leo.

She looked quite put out. "But I want to know!"

"Bring it along," Silver suggested, "and take it apart later." Her eyes flicked up and down the corridor; Leo was slightly consoled that at least one quaddie shared his sense of urgency.

"Yes, later," Leo agreed, for the sake of expediency. "Let's *go* now." He tucked the roller pallet firmly under his arm, to thwart further experimentation. The quaddies, he reflected, didn't seem to have a very clear idea of private property. Probably came from a lifetime spent in a communal space habitat, with its tight ecology. Planets were communal in the same way, really, except that their enormous size put so much slack in their systems, it was disguised.

Habits of thought, indeed. Here he worried over the theft of a roller pallet, while planning the greatest space heist in human history. Ti almost bolted when he found out what the rest of the assignment they had planned for him was to be. Leo, prudently, didn't fill in these details until the pusher was safely launched from the Transfer Station and halfway back to the Habitat.

"You want *me* to hijack the Superjumper!" yelped Ti.

"No, no," Leo soothed him. "You're only going along as an adviser. The quaddies will take the ship."

"But *my* ass will depend on whether or not *they* can—"

"Then I suggest you advise well."

"Ye gods."

"The trouble with you, Ti," lectured Leo kindly, "is that you lack teaching experience. If you had, you'd have faith that the most unlikely people can learn the most amazing things. After all, you weren't born knowing how to pilot a Jump—yet lives depended on your doing it right the first time, and every time thereafter. Now you'll know how your instructors felt, that's all."

"How do instructors feel?"

Leo lowered his voice and grinned. "Terrified. Absolutely terrified."

A second pusher, packed with fuel and supplies for its long-range excursion, was waiting in the slot next to

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theirs as they docked at the Habitat. Leo resisted a strong urge to take Ti aside and fill his ear with advice and suggestions for his mission. Alas, their experience in criminal theft was all too comparable—zero equalled zero no matter how unequal the years each was multiplied by.

They floated through the hatch into the docking module to find several anxious quaddies waiting for them.

"I've modified more solderers, Leo," Pramod began unnecessarily—three of his four hands clutched the improvised arsenal to his torso. "One each for five people."

Claire, hovering at his shoulder, eyed the weapons with dread fascination.

"Good. Give them to Silver, she'll have charge of them until the pusher gets to the wormhole," said Leo.

They made their way down the hand grips to the next hatch. Zara swung within to begin her pre-flight checks.

Ti craned his neck after her nervously. "Are we leaving right now?"

"Time is critical," said Leo. "We don't have more than four hours till you're missed at the Transfer Station."

"Shouldn't there be a—a briefing, or something?"

Ti too, Leo appreciated, was having trouble committing himself to falling free. Well, *jumped* or *was pushed*, after the initial impulse it would make no practical difference.

"You'll have almost twenty-four hours, boosting at one *g* to midpoint and then flipping and braking the rest of the way, to work out your plan of attack. Silver will be depending on your knowledge of the Superjumpers. We've already discussed various methods of achieving surprise. She'll fill you in."

"Oh, is Silver going?"

"Silver," Leo enlightened him gently, "is in command."

Ti's face flickered through an array of expressions, settled on dismay. "Screw this. There's still time for me to go back and catch my ship—"

"And *that*," Leo overrode him, "is precisely why Silver is in charge. Your capture of a cargo Jumper is the signal for a quaddie uprising here on the Habitat. And that uprising is their death warrant. When GalacTech discovers it cannot control the quaddies, it will almost certainly be frightened into an attempt to violently exterminate them. Escape must be assured before we tip our hand. The ship you must catch is out that way." Leo pointed. "I can depend on Silver to remember that. You," Leo smiled thinly, "are no worse than anyone else."

Ti subsided at that, although not happily.

Silver, Zara, Siggy, a particularly husky quaddie from the pusher crews named Jon, and Ti. Five, crammed into a ship meant for a crew of two and not designed for overnight use in any case. Leo sighed. The Superjumpers carried a pilot and an engineer. Five-to-two wasn't altogether bad odds, but Leo wished he could have loaded them even more overwhelmingly in the quaddies' favor.

They filed through the flex tube into the pusher. Silver, at the end, paused to embrace Pramod and Claire, who had lingered to see them off.

"We're going to get Andy back,"

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Silver murmured to Claire. "You'll see."

Claire nodded, and hugged her hard.

Silver turned last to Leo, who was gazing doubtfully at the flex tube through which the crew he'd drafted had gone.

"I thought the quaddies were going to be the weak link in this hijacking operation," jittered Leo, "now I'm not so sure. Don't let Ti cave on you, eh, Silver? Don't let him bring you down. You have to succeed."

"I know. I'll try. Leo . . . why ever did you think Ti was in love with me?"

"I don't know. . . . You were intimate—the power of suggestion, maybe. All those romances."

"Ti doesn't read romances, he reads 'Ninja of the Twin Stars'."

"Weren't you in love with him? At first, anyway?"

She frowned. "It was exciting to be beating the rules with him. But Ti is . . . well, is Ti. Love like in the books—I always knew it wasn't really real. When I got to looking around, at our own downsiders, nobody was like that. I guess I was stupid, to like those stories so much."

"I suppose they're not realistic—I haven't read them either, to tell you the truth. But it's not stupid to want something more, Silver."

"More than what?"

More than to be worked over by a lot of self-centered legged louts, that's what. We're not all like that . . . are we? Why, after all, was he being moved *now* to lay a load of his own on her, when she needed all her concentration for the task ahead? Leo shook his head. "Anyway, don't let Ti get confused between his Ninja-whatsit and what you're trying to do, either."

"I don't think even Ti could mistake a company Jump ship crew for the Black League of Eridani," said Silver.

Leo could have wished for more certainty in her tone. "Well . . ." he cleared his throat, inexplicably blocked, "take care. Don't get hurt."

"You be careful too." She did not hug him, as she had Pramod and Claire.

"Right."

And don't ever believe, his mind cried after her as she vanished into the flex tube, *that nobody could love you, Silver . . .* But it was too late to call the words aloud. The airseal doors shut with a sigh like regret.

CHAPTER TEN

The freight shuttle docking bay was chilly, and Claire rubbed all her hands together to warm them. Only her hands seemed cold, her heart beat hot with anticipation and dread. She looked sideways at Leo, floating as seemingly stolid as ever by the airseal doors with her.

"Thanks, for pulling me off my work shift for this," Claire said. "Are you sure you won't get into trouble, when Mr. Van Atta finds out?"

"Who's to tell him?" said Leo. "Besides, I think Bruce is losing interest in tormenting you. Everything's so obviously futile. All the better for us. Anyway, I want to talk to Tony, too, and I figure I'll have a better chance of getting his undivided attention after you've got the reunion bit over with." He smiled reassuringly.

"I wonder what condition he'll be in?"

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"You may be sure he's much better, or Dr. Minchenko wouldn't be subjecting him to the stresses of travel, even to keep him close under his eye."

A thump, and the whir and grind of machinery, told Claire that the shuttle had arrived in its clamps. Her hands reached out, drew in self-consciously. The quaddie manning the control booth waved to two others in the bay, and they locked the flex tubes into position and sealed them. The personnel tube opened first, and the shuttle's engineer stuck his head through to double check everything, then whipped back out of sight. Claire's heart lurched in her chest, and her throat constricted dryly.

Dr. Minchenko emerged at last and hovered a moment, one hand anchored to a grip by the hatch. A leathery-faced, vigorous man, his hair was as white as the GalacTech medical service coveralls he wore. He had been a big man, now shrunken to his frame like a withered apricot, but, like a withered apricot, still sound. Claire had the impression he only needed to be rehydrated and he'd pop back to like-new condition.

Dr. Minchenko shoved off from the hatchway and crossed the bay toward them, landing accurately by the grips around the airseal doors. "Why, hullo, Claire," he said in a surprised voice. "And, ah—Graf," he added less cordially. "You're the one. Let me tell you, I don't appreciate being leaned on to authorize violation of sound medical protocol. You are to spend double time in the gym for the duration of your extension, you hear?"

"Yes, Dr. Minchenko, thank you," said Leo promptly, who was not, as far as Claire knew, spending any time in the gym at all these days. "Where's Tony? Can we help you get him to the infirmary?"

"Ah," Minchenko looked more closely at Claire. "I see. Tony's not with me, dear, he's still in hospital downside."

Claire stifled a gasp. "Oh, no—is he worse?"

"Not at all. I had fully intended to bring him with me. In my opinion, he needs free fall to complete his recovery. The problem is, um, administrative, not medical. And I'm on my way right now to resolve it."

"Did Bruce order him kept downside?" asked Leo.

"That's right." He frowned at Leo. "And I'm not pleased to have my medical responsibilities interfered with, either. He'd better have a mighty convincing explanation. Daryl Cay wouldn't have permitted a screw-up like this."

"You, um . . . haven't heard the new orders yet, then?" said Leo carefully, with a warning glance at Claire —*hush* . . .

"What new orders? I'm on my way to see the little schmuck—that is, the man right now. Get to the bottom of this . . ." He turned to Claire, switching firmly to a kinder tone. "It's all right, we'll get it straightened out. All Tony's internal bleeding has stopped, and there's no further sign of infection. You quaddies are tough. You hold your health much better in gravity than we downsiders do in free fall. Well, we explicitly designed you not to undergo deconditioning. I could only wish the confirming experiment hadn't happened under such distressing conditions. Of course," he sighed, "youth has some-

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thing to do with it . . . Speaking of youth, how's little Andy? Sleeping better for you now?"

Claire almost burst into tears. "I don't know," she squeaked, and swallowed hard.

"What?"

"They won't let me see him."

"*What?*"

Leo, studying his fingernails distantly, put in, "Andy was removed from Claire's care. On charges of child-endangering, or some such thing. Didn't Bruce tell you that either?"

Dr. Minchenko's face was darkening to a brick-red hue. "Removed? From a breast-feeding mother—obscene!" His eyes swept back over Claire.

"They gave me some medicine to dry me up," explained Claire.

"Well, that's something . . ." his mollification was slight. "Who did?"

"Dr. Curry."

"He didn't report it to me."

"You were on leave."

" 'On leave' doesn't mean 'incommunicado'. You, Graf! Spit it out. What the hell's going on around here? Has that pocket-martinet lost his mind?"

"You really haven't heard. Well, you'd better ask Bruce. I'm under direct orders not to discuss it."

Minchenko gave Leo a stabbing glare. "I shall." He pushed off and entered the corridor through the airseal doors, muttering under his breath.

Claire and Leo were left looking at each other in dismay.

"How are we going to get Tony back now?" cried Claire. "It's less than twenty-four hours till Silver's signal!"

"I don't know—but don't cave now! Remember Andy. He's going to need you."

"I'm not going to cave," Claire denied. She took a steadying gulp of air. "Not ever again. What can we do?"

"Well, I'll see what strings I can pull, to try and have Tony brought up—bullshit Bruce, tell him I have to have Tony to supervise his welding gang or something—I'm not sure. Maybe Minchenko and I together can work something, though I don't want to risk rousing Minchenko's suspicions. If I can't," Leo inhaled carefully, "we'll have to work out something else."

"Don't lie to me, Leo," said Claire dangerously.

"Don't leap to conclusions. Yes, I know—you know—the possibility exists that we won't be able to retrieve him, all right, I said it, right out loud. But please note any, er, alternative scenarios depend on Ti to pilot a shuttle for us, and must wait until we reconnect with the hijack crew. At which point we will have captured a jumpship, and I will begin to believe that anything is possible." His brows quirked, stressed. "And if it's possible, we'll try it. Promise."

There was a growing coldness in her. She firmed her lips against their tremble. "You can't risk everybody for the sake of just one. That's not right."

"Well . . . there are a thousand things that can go wrong between now and some—point of no return for Tony. It may turn out to be quite academic. I do know, dividing our energies among a thousand what-ifs instead of concentrating them for the one sure next step is a kind of self-sabotage. It's not what we do next week, it's what we do next,

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that counts most. What must you do next?"

Claire swallowed, and tried to pull her wits back together. "Go back to work . . . pretend like nothing's going on. Continue the secret inventory of all possible seed stocks. Uh, finish the plan of how we're going to hook up the grow-lights to keep the plants going while the Habitat is moved away from the sun. And as soon as the Habitat is ours, start the new cuttings and bring the reserve tubes on-line, to start building up extra food stocks against emergencies. And, uh, arrange cryo-storage of samples of every genetic variety we have on board, to restock in case of disaster—"

"That's enough!" Leo smiled encouragement. "The next step only! And you *know* you can do that."

She nodded.

"We need you, Claire," he added. "All of us, not just Andy. Food production is one of the fundamentals of our survival. We'll need every pair, er, every set of expert hands. And you'll have to start training youngsters, passing on that how-to knowledge that the library, no matter how technically complete, can't duplicate."

"I am not going to cave," Claire reiterated through her teeth, answering the undercurrent, not the surface, of his speech.

"You scared me, that time in the airlock" he apologized, embarrassed.

"I scared myself," she admitted.

"You had a right to be angry. Just remember, your true target isn't in here—" he touched her collarbone, above her heart, fleetingly. "It's out there."

So, he had recognized it was rage, rage blocked and turned inward, and not despair, that had brought her to the airlock that day. In a way, it was a relief to put the right name to her emotion. In a way it was not.

"Leo . . . that scares me too."

He smiled quizzically. "Welcome to the human club."

"The next step," she muttered. "Right. The next *reach*." She gave Leo a wave, and swung into the corridor.

Leo turned back to the freight bay with a sigh. The next-step speech was all very well, except when people and changing conditions kept switching your route around in front of you while your foot was in the air. His gaze lingered a moment on the quaddie docking crew, who had connected the flex tube to the shuttle's large freight hatch and were unloading the cargo into the bay with their power handlers. The cargo consisted of man-high grey cylinders, that Leo did not at first recognize.

But the cargo wasn't supposed to be unrecognizable. The cargo was supposed to be a massive stock of spare cargo-pusher fuel rods. "For dismantling the Habitat," Leo had sung dulcetly to Van Atta, when jamming the requisition through. "So I won't have to stop and reorder. So what if we have leftovers, they can go to the Transfer Station with the pushers when they're relocated. Credit them to the salvage."

Disturbed, Leo drifted over to the cargo workers. "What's this, kids?"

"Oh, Mr. Graf, hello. Well, I'm not quite sure," said the quaddie boy in the canary-yellow T-shirt and shorts of Airsystems Maintenance, of which Docks & Locks was a subdivision. "I don't

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think I've ever seen it before. It's massive, anyway." He paused to unhook a report panel from his power-handler and gave it to Leo. "There's the freight manifest."

"It was supposed to be cargo-pusher fuel rods . . ." The cylinders *were* about the right size. They surely couldn't have redesigned them. Leo tapped the manifest keypad—item, a string of code numbers, quantity, astronomical.

"They gurgle," the yellow-shirted quaddie added helpfully.

"Gurgle?" Leo looked at the code number on the report panel more closely, glanced at the grey cylinders—they matched. Yet he recognized the code for the pusher rods—or did he? He entered "Fuel Rods, Orbital Cargo Pusher Type II, cross ref, inventory code." The report panel blinked and a number popped up. Yes, it was the same—no, by God! G77618PD, versus the G77681PD emblazoned on the cylinders. Quickly he tapped in "G77681PD." There was a long pause, not for the report panel but for Leo's brain to register.

"Gasoline?" Leo croaked in disbelief. "*Gasoline?* Those idiots actually shipped a hundred tons of *gasoline* to a space station . . .?"

"What is it?" asked the quaddie.

"Gasoline. It's a hydrocarbon fuel used downside, to power their land rovers. A freebie by-product from the petrochemical cracking. Atmospheric oxygen provides the oxidant. It's a bulky, toxic, volatile, flammable —explosive liquid at room temperature. For God's sake don't let any of those barrels get open."

"Yes, *sir*," promised the quaddie, clearly impressed with Leo's list of hazards.

The legged supervisor of the orbital pusher crews arrived at that moment in the bay, trailed by a gang of quaddies from his department.

"Oh, hello, Graf. Look, I think it was a mistake letting you talk me into ordering this load—we're going to have a storage problem—"

"Did you order this?" Leo demanded.

"What?" the supervisor blinked, then took in the scene before him. "What the—where are my fuel rods? They told me they were here."

"I mean did you, personally, place the order. With your own little fingers."

"Yes. You asked me to, remember?"

"Well," Leo took a breath, and handed him the report panel, "you made a typo."

The super glanced at the report panel, and paled. "Oh, God."

"And they did it," Leo gibbered, running his hands through what was left of his hair, "they filled it—I can't believe they filled it. Loaded all this stuff onto the shuttle without once questioning it, sent a hundred tons of gasoline to a space station without *once* noticing that it was utterly absurd . . ."

"I can believe it," sighed the super. "Oh, God. Oh, well. We'll just have to send it back, and reorder. It'll probably take about a week. It's not like our fuel rod stocks are really low, in spite of the rate you've been using them up for that 'special project' you're so hushy-hush about."

I don't have a week, thought Leo frantically. *I have twenty-four hours, maybe.*

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"I don't have a week," Leo found himself raging. "I want them *now*. Put it on a rush order." He lowered his voice, realizing he was becoming conspicuous.

The super was offended enough to overcome his guilt. "There's no need to throw a fit, Graf. It was my mistake and I'll probably have to pay for it, but it's plain stupid to charge my department for a rush shuttle trip on top of this one when we can perfectly well wait. This is going to be bad enough as it is." He waved at the gasoline. "Hey, kids," he added, "stop unloading! This load's a mistake, it's all gotta go back downside."

The shuttle pilot was just exiting the personnel hatch in time to hear this. "What?" He floated over to them, and Leo gave him a brief explanation in very short words of the error.

"Well, you can't send it back on this trip," said the shuttle pilot firmly. "I'm not fueled up to take a full load. It'll have to wait." He shoved off, to take his mandatory safety break in the cafeteria.

The quaddie cargo handlers looked quite reproachful, as the direction of their work was reversed for the second time. But they limited their implied criticism to a plaintive, "Are you sure now, sir?"

"Yes," sighed Leo. "But find some place to store this stuff in a detached module, you can't leave it in here."

"Yes, sir."

Leo turned again to the pusher crew supervisor. "I've still got to have those fuel rods."

"Well, you'll just have to wait. I won't do it. Van Atta's going to have enough of my blood for this already."

"You can charge it to my special project. I'll sign for it."

The super raised his eyebrows, slightly consoled. "Well . . . I'll try, all right, I'll try. But what about your blood?"

Already sold, thought Leo. "That's my look-out, isn't it?"

The super shrugged. "I guess." He exited, muttering. One of the pusher crew quaddies, trailing him, gave Leo a significant look; Leo returned a severe shake of his head, emphasized by a throat-cutting gesture with his index finger, indicating, Silence!

He turned and nearly rammed Pramod, waiting patiently at his shoulder. "Don't sneak up on me like that!" he yelped, then got better control of his fraying nerves. "Sorry, you startled me. What is it?"

"We've run into a problem, Leo."

"But of course. Who ever tracks me down to impart good news? Never mind. What is it?"

"Clamps."

"Clamps?"

"There's a lot of clamped connections Outside. We were going over the flow chart for the Habitat disassembly, for, um, tomorrow, you know—"

"I know, don't say it."

"We thought a little practice might speed things up."

"Yes, good . . ."

"Hardly any of the clamps will unclamp. Even with power tools."

"Uh . . ." Leo paused, taken aback, then realized what the problem was. "Metal clamps?"

"Mostly."

"Worse on the sun side?"

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"Much worse. We couldn't get any of those to come at all. Some of them are visibly fused. Some idiot must have welded them."

"Welded, yes. But not by some idiot. By the sun."

"Leo, it doesn't get *that* hot—"

"Not directly. What you're seeing is spontaneous vacuum diffusion welding. Metal molecules are evaporating off the surfaces of the pieces in the vacuum. Slowly, to be sure, but it's a measurable phenomenon. On the clamped areas they migrate into their neighboring surfaces and eventually achieve quite a nice bond. A little faster for the hot pieces on the sun side, a little slower for the cold pieces in the shade—but I'll bet some of those clamps have been in place for twenty years."

"Oh. But what do we do about them?"

"They'll have to be cut."

Pramod's lips pursed in worry. "That will slow things down."

"Yeah. And we'll have to have a way set up to re-clamp each connection in the new configuration, too . . . gonna need more clamps, or something that can be made to work as clamps . . . Go round up all your off-shift work gang. We're going to have to have a little emergency scrounging session."

Leo stopped wondering if he was going to survive the Great Takeover, and started wondering if he was going to survive *until* the Great Takeover. He prayed devoutly that Silver was having an easier time of it than himself.

Silver hoped earnestly that Leo was having an easier time of it than herself.

She hitched herself around in the acceleration couch, increasingly uncomfortable after their first eight hours of flight, and rested her chin on the padding to regard her crew, crammed in the pusher's cabin. The other quaddies were drooped and draped as she was; only Ti seemed comfortable, feet propped up and leaning back in his seat in the steady *g*-forces.

"I saw this great holovid," Siggy waved some hands enthusiastically, "that had a boarding battle. The marines used magnetic mines to blow holes like bubble cheese in the side of the mothership and just poured through." He added a weird ululating cry for sound effects. "The aliens were running every which way, stuff flying everywhere as the air blew out—"

"I saw that one," said Ti. "*Nest of Doom*, right?"

"You got it for us," reminded Silver.

"Did you know it had a sequel?" said Ti aside to Siggy. "*The Nest's Revenge*."

"No, really? Do you suppose—"

"First of all," said Silver, "nobody has found any intelligent aliens yet, hostile or not, secondly, we don't have any magnetic mines," *thanks be*, "and thirdly, I don't think Ti wants a lot of unsightly holes blown in the side of his ship."

"Well, no," conceded Ti.

"We will go in through the airlock," said Silver firmly, "which was designed for just that purpose. I think the jumpship crew will be surprised enough when we put them in their escape pod and launch it, without, um, frightening them into doing who-knows-what with a lot of premature whooping. Even if Colonel Wayne in *Nest of Doom* led his troops

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into battle with his rebel yell over their comm links, I don't think real marines would do that. It would be bound to interfere with their communications." She frowned Siggy into submission.

"We'll just do it Leo's way," Silver went on, "and point the laser-solderers at them. They don't know us, they wouldn't know whether we'd fire or not." How, after all, could strangers know what she didn't know herself? "Speaking of which, how do we know which Superjumper to," she groped for terminology, "cut out of the herd? It ought to be easier to get permission to come aboard if the crew's someone Ti knows well. On the other hand, it might be harder to . . ." she trailed off, disliking the thought. "Especially if they tried to fight back."

"Jon could wrestle them into submission," offered Ti. "That's what he's here for, after all."

Husky Jon gave him a woeful look. "I thought I was here as the pusher back-up pilot. You wrestle them if you want, they're your friends. I'll hold a solderer."

Ti cleared his throat. "Anyway, I'd like to get D771, if it's there. We aren't going to have much choice, though. There's only likely to be a couple of Superjumpers working this side of the wormhole at any one time anyway. Basically, we go for whatever ship that's just jumped over from Orient IV and dumped its empty pod bundles, and hasn't started to load on new ones yet. That'll give us the quickest getaway. There's not that much to plan, we just go *do* it."

"The real trouble will start," said Silver, "when they've figured out what we're really up to and start trying to take the ship back."

A glum silence fell. For the moment, even Siggy had no suggestions.

Leo found Van Atta in the downsiders' gym, tramping determinedly on the treadmill. The treadmill was a medical torture device like a rack in reverse. Spring-loaded straps pulled the walker toward the tread surface, against which his or her feet pushed, for an hour or more a day by prescription, an exercise designed to slow, if not stop, the lower body deconditioning and long bone demineralization of free fall dwellers.

By the expression on Van Atta's face he was stamping out the measured treads today with considerable personal animosity. Cultivated irritation was indeed one way to muster the energy to tackle the boring but necessary task. After a moment's thoughtful study Leo decided upon a casual and oblique approach. He slipped out of his coveralls and Velcroed them to the wall-strip, retaining his red T-shirt and shorts, and floated over and hooked himself into the belts and straps of the unoccupied machine next to Van Atta's.

"Have they been lubricating these things with glue?" he puffed, grasping the hand holds and straining to start the treads moving against his feet.

Van Atta turned his head and grinned sardonically. "What's the matter, Leo? Did Minchenko the medical mini-dictator order a little physiological revenge on you?"

"Yeah, something like that . . ." he got it started at last, his legs flexing in an even rhythm. He *had* skipped too

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many sessions lately. "Have you talked to him since he came up?"

"Yeah." Van Atta's legs drove against his machine, and angry whirring spurted from its gears.

"Have you told him what's going to be happening to the Project yet?"

"Unfortunately, I had to. I'd hoped to put him off to the last, with the rest. Minchenko is probably the most arrogant of Cay's Old Guard—he's never made it a secret that he thought he should have succeeded Cay as Head of Project, instead of bringing in an outsider, namely me. If he hadn't been slated for retirement in a year, I'd damn well have taken steps to get rid of him before this."

"Did he, ah—voice objections?"

"You mean, did he yowl like a stuck pig? You bet he did. Carried on like *I* was personally responsible for inventing the damned artificial gravity. I don't need this shit." Van Atta's treadmill moaned in counterpoint to his words.

"If he's been with the Project from the beginning, I guess the quaddies are practically his life's work," allowed Leo reasonably.

"Mm." Van Atta marched. "It doesn't give him the right to go on strike in a snit, though. Even you had more sense, in the end. If he doesn't show signs of a more cooperative attitude when he's had a chance to calm down and think through how useless it is, it may be easier to extend Curry's rotation and just send Minchenko back downside."

"Ah." Leo cleared his throat. This didn't exactly smell like the good opening he'd been hoping for. But there was so little time. "Did he talk to you about Tony?"

"Tony!" Van Atta's treadmill buzzed like a hornet for a moment. "If I never see that little geek again in my life it will be too soon. He's been nothing but trouble, trouble and expense."

"I was rather hoping to get some more use out of him, myself," said Leo carefully. "Even if he's not medically ready to go back on regular Outside work shifts, I've got a lot of computer console work and supervisory tasks I could delegate to him, if he was here. If we could bring him up."

"Nonsense," snapped Van Atta. "You could much more easily tap one of your other quaddie work gang leaders—Pramod, say—or pull any quaddie in the place. I don't care who, that's what I gave you the authorization for. We're going to start moving the little freaks *down* in just two weeks. It makes no sense to bring up one Minchenko wouldn't let out of the infirmary till then. And so I told him." He glared at Leo. "I don't want to hear one more word about Tony."

"Ah," said Leo. Damn. Clearly, he should have taken Minchenko aside before he'd muddied the waters with Van Atta. Too late now. It wasn't just the exercise that was making Van Atta red in the face. Leo wondered what Minchenko had really said—doubtless pretty choice, it would have been a pleasure to hear. Too expensive a pleasure for the quaddies, though. Leo schooled his features to what he hoped would be read through his puffing and blowing as sympathy for Van Atta.

"How's the salvage planning going?" asked Van Atta after a while.

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"Almost complete."

"Oh, really?" Van Atta brightened. "Well, that's something, at least."

"You'll be amazed at how totally the Habitat can be recycled," Leo promised with perfect truth. "So will the company brass."

"And fast?"

"Just as soon as we get the go-ahead. I've got it laid out like a war game." He closed his teeth on further double entendres. "You still planning the Grand Announcement to the rest of the staff at 1300 tomorrow?" Leo inquired casually. "In the main lecture module? I really want to be in on that, I have a few visual aids to present when you're done."

"Naw," said Van Atta.

"What?" Leo gulped. He missed a step, and the springs slammed him painfully down on one knee on the treadmill, padded against just such clumsiness. He struggled back to his feet.

"Did you hurt yourself?" said Van Atta. "You look funny . . ."

"I'll be all right in a minute," He stood, leg muscles straining against the elastic pull, regaining his breath and equilibrium in the face of pain and panic. "I thought—that was how you were going to drop the shoe. Get everybody together, just go over the facts once."

"After Minchenko, I'm tired of arguing about it," said Van Atta. "I've told Yei to do it. She can call them into her office in small groups, and hand out the individual and department evacuation schedules at the same time. Much more efficient."

And so Leo and Silver's beautiful scheme for peacefully detaching the downsiders, hammered out through four secret planning sessions, was blown away on a breath. Wasted was the flattery, the oblique suggestion, that had gone into convincing Van Atta that it was his idea to gather, unusually, the entire Habitat downsider staff at once and make his announcement in a speech persuading them all they were being commended, not condemned. . . .

The shaped charges to cut the lecture module away from the Habitat at the touch of a button were all in place. The emergency breath masks to supply the nearly three hundred bodies with oxygen for the few hours necessary to push the module around the planet to the Transfer Station were carefully hidden within. The two pusher crews were drilled, their pushers fueled and ready.

Fool he had been, to lay plans that depended on Van Atta following through on anything . . . Leo felt suddenly sick.

It was going to have to be the second-choice plan, then, the emergency one they'd discussed and discarded as too risky, too potentially uncontrolled in its results. Numbly, he detached his springs and harness and hooked them back in their slots on the treadmill frame.

"That wasn't an hour," said Van Atta.

"I think I did something to my knee," lied Leo.

"I'm not surprised. Think I didn't know you've been skipping exercise sessions? Just don't try to sue GalacTech, 'cause we can prove personal neglect." Van Atta grinned and marched on virtuously.

Leo paused. "By the way, did you know that Rodeo Warehousing just misshipped the Habitat a hundred tons of

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gasoline? And they're charging it to us."

"What?"

As Leo turned away he had the small vindictive satisfaction of hearing Van Atta's treadmill stop and the snap of a too-hastily-detached harness rebounding to slap its wearer. "Ow!" Van Atta cried.

Leo did not look back.

Dr. Curry met Claire as she arrived for her appointment at the infirmary. "Oh, good, you're just on time."

Claire glanced up and down the corridor, and her eyes searched the treatment room into which Dr. Curry shooed her. "Where's Dr. Minchenko? I thought he'd be here."

Dr. Curry flushed faintly. "Dr. Minchenko is in his quarters. He won't be coming on duty."

"But I wanted to talk to him . . ."

Dr. Curry cleared his throat. "Did they tell you what your appointment was for?"

"No . . . I supposed it was for more medication for my breasts."

"Ah, I see."

Claire waited a moment, but he did not expand further. He busied himself, laying out a tray of instruments by their Velcro collars and placing them in the sterilizer, not meeting Claire's eyes. "Well, it's quite painless."

Once, she might have asked no questions, docilely submitting—she had undergone thousands of obscure medical tests starting even before she had been freed as an infant from the uterine replicator, the artificial womb that had gestated her in a now-closed section of this very infirmary. Once, she had been another person, before the downside disaster with Tony. For a little time thereafter she had hovered close to being no one at all. Now she felt strangely thrilled, as if she trembled on the edge of a new birth. Her first had been mechanical and painless, perhaps that was why it had failed to take root. . . .

"What—" she began to squeak. Too tiny a voice. She raised it, loud in her own ears. "What *is* this appointment for?"

"Just a small local abdominal procedure," said Dr. Curry airily. "It won't take long. You don't even have to get undressed, just roll up your shirt and push down your shorts a bit. I'll prep you. You have to be immobilized under the sterile-air-flow shield, in case a drop or two of blood gets on the loose."

You're not immobilizing me . . . "What is the procedure?"

"It won't hurt, and will do you no harm at all. Come on over, now." He smiled, and tapped the shield unit, which folded out from the wall.

"What?" repeated Claire, not moving.

"I can't discuss it. It's—classified. Sorry. You'll have to ask—Mr. Van Atta, or Dr. Yei, or somebody. Tell you what, I'll send you over to Dr. Yei right after, and you can talk to her, all right?" He licked his lips; his smile grew steadily more nervous.

"I wouldn't ask—" Claire groped after a phrase she had heard a downsider use once, "I wouldn't ask Bruce Van Atta for the time of day."

Dr. Curry looked quite startled. "Oh." And muttered, not quite under his breath,

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"I wondered why you were second on the list."

"Who was first on the list?" asked Claire.

"Silver, but that engineering instructor has her on some kind of assignment. Friend of yours, right? You'll be able to tell her it doesn't hurt."

"I don't care—I don't give a *damn* if it hurts, I want to know what it *is*." Her eyes narrowed, as the connections clicked at last, then widened in outrage. "The sterilizations," she breathed. "You're starting the sterilizations!"

"How did you—you weren't supposed—I mean, whatever makes you think that?" gulped Curry.

She dodged for the doorway. He was closer and quicker, and sealed it in front of her nose. She caroomed off the closing panel.

"Now, Claire, calm down!" panted Curry, zigzagging after her. "You'll only hurt yourself, totally unnecessarily. I can put you under a general anesthetic, but it's better for you to use a local, and just lie still. You do have to lie still. I have to do this, one way or another—"

"Why do you *have* to do this?" cried Claire. "Did Dr. Minchenko *have* to do this—or is that why he isn't here? Who's making you, and how, that you *have* to?"

"If Minchenko was here, I *wouldn't* have to," snapped Curry, infuriated. "He ducked out, and left me holding the bag. Now come over here and position yourself under the steri-shield, and let me set up the scanners, or I'll have to get—get quite *firm* with you." He inhaled deeply, psyching himself up.

"Have to," Claire taunted, "have to, have to! It's amazing, some of the things downsiders think they have to do. But they're almost never the same things they think quaddies have to do. Why is that, do you suppose?"

His breath woofed out, and his lips tightened angrily. He plucked a hypodermic off his tray of instruments.

He laid it out in advance, Claire thought. *He's rehearsed this, in his mind—he made his mind up before I ever got here. . . .*

He launched himself over to where she hovered, and grabbed her left upper arm, stabbing the needle towards it in a swift silver arc. She grabbed his right wrist, slowing it to a straining standstill; so they were locked for a moment, muscles trembling, tumbling slowly in the air.

Then she brought up her lower arms to join her uppers. Curry gasped in surprise, and for breath, as she parted his arms wide, overpowering even his young male torso. He kicked, his knees thumping her, but with nothing to push against he couldn't drive them with enough force to really hurt.

She grinned in wild exhilaration, brought his arms in, out again at will. *I'm stronger! I'm stronger! I'm stronger than him and I never even knew it.*

Carefully, she locked her power-gripping lower hands around his wrists, and freed her uppers. Both hands working together easily peeled his clutching fingers from the hypodermic. She held it up, and crooned. "This won't hurt a bit."

"No, no—"

He was wriggling too much for her inexperience to try for a swift venous injection, so she went for a deltoid mus-

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cle instead, and went on holding him until he grew woozy and weak, which took several minutes. After that, it was easy to immobilize him under the steri-shield.

She looked over his tray of instruments, and touched them wonderingly. "How far should I carry this turnabout, do you think?" she asked aloud.

He whimpered in his wooziness and twitched feebly against the soft restraints, panic in his eyes. Claire's eyes lit; she threw back her head and laughed, really laughed, for the first time in—how long? She couldn't remember.

She put her lips near his ear, and spoke clearly. "*I don't* have to."

She was still laughing softly when she sealed the doors to the treatment room behind her and flew down the corridor toward refuge.

CHAPTER ELEVEN

It had been a mistake to let Ti insist on docking to the Superjumper, Silver realized, as the crunch and shudder of their impact with the docking clamps reverberated through the pusher. Zara, hovering anxiously, emitted a tiny moan. Ti snarled wordlessly over his shoulder at her, returned his fraying attention to the controls.

No—*her* mistake, to let his downsider, male, legged authority override her own reason—she knew he wasn't rated for these pushers, he'd told her so himself. He was only the authority after they got inside the Superjumper.

No, she told herself firmly, *not even then*.

"Zara," she called, "take the controls."

"Dammit," Ti began, "if you'd just—"

"We need Ti too much on the comm channels to spare him for piloting," Silver inserted, hoping desperately Ti would not spurn this offered sop for his pride.

"Mm." Grudgingly, Ti let Zara shoulder him aside.

The flex tube locking ring wouldn't seal properly. A second docking, and all the hopeful jiggling the auto-waldos could supply, couldn't make the locking ring seal properly. Silver either feared she would die, or wished she could, she wasn't sure. All her palms sweated, and transferring the laser-solderer from one to another only made the grip clammier.

"See," said Ti to Zara, "you can't do any better."

Zara glared at him. "You bent one of the rings, you dipstick. You better hope it's theirs and not ours."

"That's 'dipshit'," Jon, laboring back by the hatch trying to make it seal, corrected helpfully. "If you're going to use downsider terminology, get it right."

"Pusher R-26 calling GalacTech Superjumper D620," Ti quavered into the comm. "Von, we're going to have to disengage and come around to the other side. This isn't working."

"Go ahead, Ti," came the Jump pilot's voice in return. "Are you sick? You don't sound so good. That was a miserable docking. Just what *is* this emergency, anyway?"

"I'll explain when we're aboard." Ti glanced up, got a confirming nod from Zara. "Disengaging now."

Their luck was better on the starboard hatch. *No*, Silver reminded herself again. *We make our own luck. And it's my*

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responsibility to see it's good and not bad. Ti pushed through the flex tube first. The Jumpship's engineer was waiting for him on the other side. Silver could hear his angry voice, "Gulik, you bent our portside docking ring. You wireheads all think you're Mr. Twinkle toes when you're plugged into your sets, but on manual you are, without exception, the most ham-handed—" he broke off, his voice thinning out in a little hiss, as Silver flitted through the hatch and hovered, her laser-solderer pointed sturdily at his stomach. It actually took him a moment to notice the weapon. His eyes widened and his mouth opened as Siggy and Jon backed her up from behind.

"Take us to where the pilot is, Ti," said Silver. She hoped the fear that edged her voice made her sound angry and fierce, not pale and weak. All her strength seemed washed out of her, leaving her limp-stomached. She swallowed and took a tighter grip on the solderer.

"What the hell *is* this?" began the engineer, his voice a taut octave higher than before. He cleared his throat and brought it back down. "Who are you . . . people, anyway? Gulik, are they with you—?"

Ti shrugged and produced a sickly smile that was either very well-acted, or real. "Not exactly. I'm kind of with them."

Siggy, reminded, pointed his solderer at Ti. Silver, when approving this ploy, had kept her inner thoughts about it most secret. Going in with Ti unarmed, apparently under the quaddies' guns, covered him in case of later capture and legal prosecution. Equally, it disguised the possibility of making his ersatz kidnapping real, should he decide to bolt back to the side of his legged companions at the last moment. Wheels within wheels; did all leaders have to think on multiple levels? It made her head hurt.

They filed quickly through the compact crew's section to Nav and Com. The Jump pilot sat enthroned in his padded chair, plugged into the massive crown of his control headset, a temporary, regal cyborg. His purple company coveralls were stitched with gaudy patches proudly proclaiming his rank and specialization. His eyes were closed, and he hummed tunelessly in time to some throbbing biofeedback from his ship.

He yelped in surprise as his headset detached and rose, cutting his communion with his machine, when Ti thumbed the disconnect control. "God, Ti, don't *do* things like that—you know better—" A second yelp at the sight of the quaddies was swallowed with a gulp. He smiled at Silver in complete bewilderment, his eyes, after one shocked pass over her anatomy, locked politely on her face. She wriggled the laser-solderer, to bring it to his attention.

"Get out of your chair," she ordered.

He shrank back into it. "Look, lady . . . uh . . . what *is* that?"

"Laser gun. Get out of your chair."

His eyes measured her, measured Ti, flicked to his engineer. His hand stole to his seat harness buckle, hesitated. His muscles tensed.

"Get out slowly," Silver added.

"Why?" he asked.

Stalling, Silver thought.

"These people want to borrow your ship," Ti explained.

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"Hijackers!" breathed the engineer. He coiled, floating in his position near the airseal door. Jon's and Siggy's solderers swivelled toward him. "Mutants . . ."

"Get *out,*" Silver repeated, her voice rising uncontrollably.

The pilot's face was drawn and thoughtful. His hands floated from his belt to rest in a parody of relaxation over his knees. "What if I don't?" he challenged softly.

She fancied she could feel control of the situation slipping from her to him, sucked up by his superior imitation of coolness. She glanced at Ti, but he was staying safely and firmly in his part of helpless—and unhelpful—victim, *lying low* as the downsiders phrased it.

A heartbeat passed, another, another. The pilot began to relax, visibly in his long exhalation, a smug light of triumph in his eyes. He had her number; he knew she could not fire. His hand went to his belt buckle, and his legs curled under him, seeking launch leverage.

She had rehearsed it in her mind so many times, the actual event was almost an anticlimax. It had a glassy clarity, as if she observed herself from a distance, or from another time, future or past. The moment shaped the choice of target, something she had turned over and over without decision before; she sighted the solderer at a point just below his knees because no valuable control surfaces lay behind them.

Pressing the button was surprisingly easy, the work of one small muscle in her upper right thumb. The beam was dull blue, not enough to even make her blink, though a brief bright yellow flame flared at the edge of the melted fabric of his supposedly non-flammable coveralls, then winked out. Her nostrils twitched with the stink of the burnt fabric, more pungent than the smell of burnt flesh. Then the pilot was bent over himself, screaming.

Ti was babbling, voice strained. "What d'ja do that for? He was still strapped to his *chair,* Silver!" His eyes were wells of astonishment. The engineer, after a first convulsive movement, froze in a submissive ball, eyes flickering from quaddie to quaddie. Siggy's mouth hung open, Jon's was a tight line.

The pilot's screams frightened her, swelled up her nerves to lance through her head. She pointed the solderer at him again. "Stop that noise!" she demanded.

Amazingly, he stopped. His breath whistled past his clenched teeth as he twisted his head to stare at her through pain-slitted eyes. The centers of the burns across his legs seemed to be cauterized, shadowed black and ambiguous—she was torn between revulsion, and the curious desire to go take a closer look at what she had done. The edges of the burns were swelling red, yellow plasma already seeping through but clinging to his skin, no need for a handvac. The injury did not seem to be immediately life-threatening.

"Siggy, unstrap him and get him out of that control chair," Silver ordered. For once, Siggy zipped to obey with no argument, not even a suggestion of how to do it better gleaned from his holodrama viewing.

In fact, the effect of her action on everyone present, not just their captives, was most gratifying. Everyone moved

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faster. *This could get addictive*, Silver thought. No arguments, no complaints.

Some complaints. "Was that necessary?" Ti asked, as the prisoners were bundled ahead of them through the corridor. "He was getting out of his seat for you . . ."

"He was going to try and jump me."

"You can't be sure of that."

"I didn't think I could hit him once he was moving."

"It's not like you had no choice—"

She turned toward him with a snap; he flinched away. "If we do not succeed in taking this ship, a thousand of my friends are going to die. I had a choice. I chose. I'd choose again. You got that?" *And you choose for everybody, Silver*, Leo's voice echoed in her memory.

Ti subsided instantly. "Yes, ma'am."

Yes, ma'am? Silver blinked, and pushed ahead of him to hide her confusion. Her hands were shaking in reaction now. She entered the life-pod first, ostensibly to yank all the communications equipment but for the emergency directional finder beeper, and check for the first-aid kit—it was there, and complete—also to be alone for a moment, away from the wide eyes of her companions.

Was this the pleasure in power Van Atta felt, when everyone gave way before him? It was obvious what firing the weapon had done to the defiant pilot; what had it done to her? For every action, an equal and opposite reaction. This was a somatic truth, visceral knowledge ingrained in every quaddie from birth, clear and demonstrable in every motion.

She exited the pod. A hoarse moan broke from the pilot's lips as his legs accidently bumped against the hatch, as they stuffed him and the engineer through into the life-pod, sealed it, and fired it away from the Jumpship.

Silver's agitation gave way to a cool pool of resolve, within her, even though her hands still trembled with distress for the pilot's pain. So. Quaddies were no different from downsiders after all. Any evil they could do, quaddies could do, too. If they chose.

There. By placing the grow-tubes at this angle, with a six-hour rotation, they could get by with four fewer spectrum lights in the hydroponics module and still have enough lumens falling on the leaves to trigger flowering in fourteen days. Claire entered the command on her lap board computer and made the analog model cycle all the way through once on fast-forward, just to be sure. The new growth configuration would cut the power drain of the module by some twelve percent from her first estimate. Good, for until the Habitat reached its destination and they unfurled the delicate solar collectors again, power would be at a premium.

She shut off the lap board and sighed. That was the last of the planning tasks she could do while still locked up here in the Clubhouse. It was a good hiding place, but too quiet. Concentration had been horribly difficult, but having nothing to do, she discovered as the seconds crept on, was worse. She floated over to the cupboard and took a pack of raisins and ate them one at a time. When she finished, the gluey silence closed back in.

She imagined holding Andy again,

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his warm little fingers clutching hers in mutual security, and wished for Silver to hurry up and send her signal. She pictured Tony, medically imprisoned downside, and hoped in anguish Silver might delay, that by some miracle they might yet regain him at the last minute. She didn't know whether to push or pull at the passing minutes, only that each one seemed to physically pelt her.

The airseal doors hissed, jolting her with anxiety. Was she discovered—? No, it was three quaddie girls, Emma, Patty, and Kara the infirmary aide.

"Is it time?" Claire asked hoarsely.

Kara shook her head.

"Why doesn't it start, what's keeping Silver . . ." Claire broke off. She could imagine all too many disastrous reasons for Silver's delay.

"She'd better signal soon," said Kara. "The hunt is up all over the Habitat for you. Mr. Wyzak, the Airsystems Maintenance supervisor, finally thought of looking behind the walls. They're over in the docking bay section now. Everybody on his crew is having the most terrific outbreak of clumsiness," a curved moon of a grin winked in her face, "but they'll be working this way eventually."

Emma gripped one of Kara's lower arms. "In that case, is this really the best place for *us* to hide?"

"It'll have to do, for now. I hope things break before Dr. Curry works all the way down his list, or it's going to get awfully crowded in here," said Kara.

"Is Dr. Curry recovered, then?" asked Claire, not certain if she wanted to hear a yes or a no. "Enough to do surgery? I'd hoped he'd be out longer."

Kara giggled. "Not exactly. He's kind of hanging there all squinty-eyed and puffy, just supervising while the nurse gives the injections. Or he would be, if they could find any of the girls to give injections to."

"Injections?"

"Abortifacient," Kara grimaced.

"Oh. A different list from mine, then." So, that was why Emma and Patty looked pale, as from a narrow escape.

Kara sighed. "Yeah. Well, we're all on one list or another, in the end, I guess." She slipped back out.

Claire was cheered by the company of the other two quaddies, even though it represented a growing danger of discovery not only of themselves but of their plans. How much more could go wrong before the Habitat's downsider staff started asking the right questions? Suppose the entire plot was discovered prematurely, following up the loose end she'd left? Should she have submitted docilely to Curry's procedure, just to keep the secret a little longer? Suppose "a little longer" was all it took to make the difference between success and disaster?

"Now what, I wonder?" said Emma in a thin voice.

"Just wait. Unless you brought something to do," said Claire.

Emma shook her head. "Kara just grabbed me off my work shift in Small Repairs about ten minutes ago. I didn't think to bring anything."

"She got me out of my sleep sack," Patty confirmed. A yawn escaped her despite the tension. "I'm so tired these days."

Emma rubbed her abdomen absently

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with her lower palms in a circular motion familiar to Claire; so, the girls had already started childbirth training.

"I wonder how all this is going to go," sighed Emma. "How it will turn out. Where we'll all be in seven months . . ."

Hardly a figure chosen at random, Claire realized. "Away from Rodeo, anyway. Or dead."

"If we're dead, we won't have a problem," Patty said. "If not . . . Claire, how is labor? What's it *really* like?" Her eyes were urgent, seeking reassurance from Claire's expertise, as the sole initiate present in the maternal mysteries of the body.

Claire, understanding, responded, "It wasn't exactly comfortable, but it's nothing you can't handle. Dr. Minchenko says we have it a lot better than downsider women. We have a more flexible pelvis with a wider arch, and our pelvic floor is more elastic, on account of not having to fight the gravitational forces. He says that was his own design idea, like eliminating the hymen—whatever that was. Something painful, I gather."

"Ugh, poor things," said Emma. "I wonder if their babies ever get sucked from their bodies by the gravity?"

"I never heard of such a thing," said Claire doubtfully. "He did say they had trouble close to term with the weight of the baby cutting off circulation and squeezing their nerves and organs and things."

"I'm glad I wasn't born a downsider," said Emma. "At least not a female one. Think of the poor downsider mothers who have to worry about their helpers dropping their newborns." She shuddered.

"It's horrible, down there," Claire confirmed fervently, remembering. "It's worth risking anything, not to have to go there. Truly."

"But we'll be by ourselves, in seven months, that is," said Patty. "You had help. You had Dr. Minchenko. Emma and me—we'll be all alone."

"No, you won't," said Claire. "What a nasty thought. Kara will be there—I'll come—we'll all help."

"Leo will be coming with us," Emma offered, trying to sound optimistic. "He's a downsider."

"I'm not sure that's exactly his field of expertise," said Claire honestly, trying to picture Leo as a medtech. He didn't care for hydraulic systems, he'd said. She went on more firmly, "Anyway, all the complicated stuff in Andy's birth mostly had to do with data collecting, because I was one of the first, and they were working out the procedures, Dr. Minchenko said. Just having the baby wasn't all that much. Dr. Minchenko didn't do it—really, I didn't do it, my body did. About all he did was hold the hand-vac. Messy, but straightforward." *If nothing goes wrong biologically*, she thought, and had the last minute wit not to say aloud.

Patty still looked unhappy. "Yes, but birth is only the beginning. Working for GalacTech kept us busy, but we've been working three times as hard since this escape-thing came up. And you'd have to be a dim bulb not to see it's going to get harder later. There's no end in sight. How are we going to handle it all and babies too? I'm not sure I think much of this freedom-stuff. Leo talks

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it up, but freedom for who? Not me. I had more free time working for the company."

"You want to go report to Dr. Curry?" suggested Emma.

Patty shrugged uncomfortably. "No . . ."

"I don't think by freedom he means free time," said Claire thoughtfully. "More like survival. Like—like not having to work for people who have a right to shoot us if they want." A twinge of harsh memory edged her voice, and she softened it self-consciously. "We'll still have to work, but it will be for ourselves. And our children."

"Mostly our children," said Patty glumly.

"That's not all bad," remarked Emma.

Claire thought she caught a glimpse of the source of Patty's pessimism. "And next time—if you want a next time—*you* can choose who will father your baby. There won't be anybody around to tell you."

Patty brightened visibly. "That's true . . ."

Claire's reassurances seemed effective; the talk drifted to less threatening channels for a while. Much later, the airseal doors parted, and Pramod stuck his head in.

"We got Silver's signal," he said simply.

Claire sang out in joy; Patty and Emma hugged each other, whirling in air.

Pramod held out a cautionary hand. "Things haven't started yet. You've got to stay in here a while longer."

"No, why?" Emma cried.

"We're waiting for a special supply shuttle from downside. When it docks is the new signal for things to start happening."

Claire's heart thumped. "Tony—did they get Tony aboard?"

Pramod shook his head, his dark eyes sharing her pain. "No, fuel rods. Leo's really anxious about them. He's afraid that without them we might not have enough power to boost the Habitat all the way out to the wormhole."

"Oh—yes, of course." Claire folded back into herself.

"Stay in here, hang on, and ignore any emergency klaxons you may hear," said Pramod. His lower hands clenched together in a gesture of encouragement, and he withdrew.

Claire settled back to wait. She could have wept with the tension of it, but Patty and Emma didn't need the bad example.

Bruce Van Atta pressed a finger to one side of his nose, squeezing the nostril shut, and sniffed mightily, then switched sides and repeated the procedure. Damn free fall and its lack of proper sinus drainage, among its other discomforts. He could hardly wait to get back to Earth. Even dismal Rodeo would be an improvement. He wondered idly if he could whip up some excuse—go inspect the quaddie barracks being readied, perhaps. That could be stretched out to about five days, if he worked it right.

He drifted over and shored himself across one corner of Dr. Yei's pie-wedge-shaped office, sighting over her desk, his back to a flat inner wall and his feet braced where her magnet-board curved, thick with stuck-on papers and flimsies. Yei's lips tightened with an-

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noyance, as she swivelled to face him. He hitched his feet to a comfortably crossed position, deliberately letting them muss her papers, out-psyching the psycher. She glanced back to her holovid display, declining to rise to the bait, and he mussed a few more. *Female wimp*, he thought. A relief, that they had only a few weeks left to work together, and he didn't have to jolly her up any more.

"So," he prodded, "how far along are we?"

"Well, I don't know how you're doing—in fact," she added rather venomously, "I don't even know what you're doing—"

Van Atta grinned in appreciation. So the worm could wriggle after all. Some administrators might have taken offense at the implied insubordination; he congratulated himself upon his sense of humor.

"—but so far I've finished orienting about half the staff to their new assignments."

"Anybody give you a hard time? I'll play bad guy, if necessary," he offered nobly, "and go lean on the non-cooperative."

"Everybody is naturally rather shocked," she replied, "however, I don't think your . . . direct intervention will be required."

"Good," he said jovially.

"I do think it would have been better to tell them all at once. This business of releasing the information in bits and dribbles invites just the sort of rumormongering that is least desirable."

"Yeah, well, it's too late now—"

His words were cut short by the startling hoot of an alarm klaxon, shrilling out over the intercom. Yei's holovid was abruptly overridden by the Central Systems emergency channel.

A hoarse male voice, a strained face—good God, it was Leo Graf—sprang from the display.

"Emergency, emergency," Graf called—where was he calling from?—"we are having a depressurization emergency. This is not a drill. All Habitat downsider staff should proceed at once to the designated safe area and remain there until the all-clear sounds—"

On the holovid, a computer-generated map sketched itself showing the shortest route from this terminal to the designated safe modules—module, Van Atta saw. Holy shit, the pressurization drop must be Habitat-wide. What the hell was going on?

"Emergency, emergency, this is not a drill," Graf repeated.

Yei too was staring bug-eyed at the map, looking more like a frog than ever. "How can that be? The sealing system is supposed to isolate the problem area from the rest—"

"I bet I know," spat Van Atta. "Graf's been messing with the Habitat's structure, preparatory to salvage—I'll bet he, or his quaddies, just screwed something up royally. Unless that idiot Wyzak did something—come on!"

"Emergency, emergency," Graf's voice droned on, "this is not a drill. All Habitat downsider staff should proceed at once—son-of-a-*bitch!*" His head snapped around, winked out, leaving only the urgently pulsing map on the display.

Van Atta beat Yei, whose eye was still caught by the map, out the door to her office and through the airseal doors

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at the end of the module that should have been sealed and weren't. The doors seemed to sag half-opened, controls dead, useless, as Van Atta and Yei joined a babbling stream of staffers speeding toward safety. Van Atta swallowed, cursing his sinuses, as one ear popped and the other, throbbing, failed to. Adrenalin-spurred anxiety shivered in his stomach.

Lecture Module C was already mobbed when they arrived, with downsiders in every state of dress and undress. One of the Nutrition staff had a case of frozen food clutched under her arm—Van Atta rejected the notion that she had inside information about the duration of the emergency and decided she must have simply had it in her hands when the alarm sounded and not thought to drop it before she fled.

"Close the door!" howled a chorus of voices as his and Yei's group entered. A distinct breeze sighed past them, rising to a whistle cut to silence as the doors sealed.

Chaos and babble ruled in the crowded lecture module.

"What's going on?"

"Ask Wyzak."

"He's out there, surely, dealing with it."

"If not, he'd better *get* the hell out there—"

"Is everybody here?"

"Where are the quaddies? What about the quaddies?"

"They have their own safe area, this isn't big enough."

"Their gym, probably."

"I didn't catch any directions for them on the holovid, to the gym or anywhere else—"

"Try the comm."

"Half the channels are dead."

"Can't you even raise Central Systems?"

"Lady, I *am* Central Systems—"

"Shouldn't we have a head count? Does anybody know exactly how many there are up on rotation right now?"

"Two hundred seventy-two, but how can you know which are missing because they're trapped and which are missing because they're out there dealing with it—"

"Let me at that damned comm unit—"

"CLOSE THE DOOR!" Van Atta himself joined the chorus this time, semi-involuntarily. The pressure differential was becoming more marked. He was glad he wasn't a latecomer. If this went on it would shortly become his duty to see the doors stayed closed at any cost, no matter who was pounding for admittance from the other side. He had a little list . . . Well, anybody who lacked the wit to respond quickly to emergency instructions shouldn't be on a space station. Survival of the fittest.

If they hadn't amassed the whole two hundred seventy-two by now, they were surely getting close. Van Atta pushed his way through the bobbing crowd toward the center of the module, stealing momentum from this or that person at the price of their own displacement. A few turned to object, saw who had nudged them, and bit short their complaints. Somebody had the cover off the comm unit and was peering into its guts in frustration, lacking delicate diagnostic tools doubtless dropped somewhere back in the Habitat.

"Can't you at least raise the quaddies' gym?" demanded a young woman.

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"I've got to know if my class made it there."

"Well, why didn't you go with 'em, then?" the would-be repairman snapped logically.

"One of the older quaddies took them. He told me to come here. I didn't think to argue with him, with that alarm howling in our ears—"

"No go." Grimacing, the man clicked the cover shut.

"Well, I'm going back and find out," said the young woman decisively.

"No, you're not," interrupted Van Atta. "There's too many people breathing in here to open the door and lose air unnecessarily. Not till we find out what's going on, how extensive this is, and how long it's likely to last."

The man tapped the holovid cover. "If this thing doesn't cut in, the only way we're going to find out anything is to send out somebody with a breath mask to go check."

"We'll give it a few more minutes." Damn that overweening fool Graf. What had he done? And where was he? In a breath mask somewhere Van Atta trusted, or better yet a pressure suit—although if Graf had indeed caused this unholy mess, Van Atta wasn't sure he wished him a pressure suit. Let him have a breath mask, and a nasty case of the bends for just punishment. Idiot Graf.

So much for Graf's famous safety record. Blessings in disguise, at least the engineer wouldn't be able to jam that down his throat any more. A little humility would be good for him.

And yet—the situation was so damned anamolous. It shouldn't be possible to depressurize the whole Habitat at once. There were back-ups on the back-ups, interlocks, separated bays—any accident so system-wide would take foresight and planning.

A little hiss escaped his teeth, and Van Atta locked into himself in a sudden bubble of furious concentration, eyes widening. A planned accident—could it be, could it possibly be . . . ?

Genius Graf. An accident, an accident, a *perfect* accident, the very accident he'd most desired but had never dared wish for aloud. Was that it? That had to be it! Fatal disaster for the quaddies, now, at the last moment when they were all together and it could be accomplished at one stroke?

A dozen clues fell into place. Graf's insistence upon handling all the details of the salvage planning himself, his secretiveness, his anxiety for constant updates on the evacuation schedule—his withdrawal from social contacts that Yei had observed with disfavor, obsessive work schedule, general air of a man with a secret agenda driven to exhaustion—it was all culminating in this.

Of course it was secret. Now that he had penetrated the plot himself, Van Atta could only concur. The gratitude of the GalacTech hierarchy to Graf for relieving them of the quaddie problem must appear indirectly, in better assignments, quicker promotions—he would have to think up some suitably oblique way of transmitting it.

On the other hand—why share? Van Atta's lips drew back in a vulpine grin. This was hardly a situation where Graf could demand credit where it was due, after all. Graf had been subtle—but not subtle enough. There would have to be a sacrifice, for the sake of form, after the accident. All he had to do was keep

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his mouth shut, and . . . Van Atta had to wrench his attention back to his present surroundings.

"I've *got* to check on my quaddies!" The young woman was growing wild-eyed. She gave up on the comm unit and began to shove her way back toward the airseal doors.

"Yes," another man joined her, "and I've got to find Wyzak, he's still not here. He's bound to need help. I'll go with you—"

"No!" cried Van Atta urgently, almost adding, *You'll spoil everything!* "You're to wait for the all-clear. I won't have a panic. We'll all just sit tight and wait for instructions."

The woman subsided, but the man said skeptically, "Instructions from whom?"

"Graf," said Van Atta. Yes, it was not too early to start making it clear to witnesses where the hands-on responsibility lay. He controlled his excitement-spurred rapid breathing, trying for an aura of steady calm. Though not too calm—he must appear as surprised as any—no, more surprised than any—when the full extent of the disaster became apparent.

He settled down to wait. Minutes dragged past. One last panting group of refugees made it through the airseal doors; the Habitat-wide rate of depressurization must be slowing. One of the administrators from inventory control—old habits die hard—presented him with an unsolicited head-count of those present.

He silently cursed the census-taker's initiative, even as he accepted the results with thanks. The proof that all were not present might compel him to action he did not desire to take.

Only eleven downsider staff members had not made it. *A necessary price to pay*, Van Atta assured himself nervously. Some were doubtless holed up in other pressurized pockets, or so he could maintain he had believed, later. Their fatal mistakes could be pinned on Graf.

A group by the airseal doors was making ready to bolt. Van Atta inhaled, and paused, momentarily uncertain how to stop them without giving away everything. But a cry of dismay went up from one woman—"All the air is out of the corridor now! We can't get through without pressure suits!" Van Atta exhaled in relief.

He made his way to one of the module's viewports; it framed a dull vista of unwinking stars. The port on the other side gave an oblique view back toward the Habitat. Movement caught his eye, and he mashed his nose to the cold glass in an attempt to make out the details.

The silvery flash of worksuits, bobbing over the outside surface of the Habitat. Refugees? Or a repair party? Could his first hypothesis of a real accident be correct after all? Not good, but in any case it was still Graf's baby.

But there were quaddies out there, dammit, quaddie survivors. He could see the arms. Graf had not made his stroke complete. Just two quaddies survivors, if one was male and the other female, would be as bad as a thousand, from Apmad's point of view. Perhaps the work party was all-male.

There was Graf himself, among the flitting figures! They carried an assort-

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ment of equipment. The wavering distortion of his transverse view through the port prevented him from making out just what. He twisted his neck, craning painfully. Then the work party was eclipsed by a curve of the Habitat. A pusher slid into, and out of, his view, arcing smoothly over the lecture module. More escapees? Quaddie or downsider?

"Hey," an excited voice from within the lecture module disrupted his frantic observations. "We're in luck, gang. This whole cupboard is filled with breath masks. There must be three hundred of 'em."

Van Atta swivelled his head to spot the cupboard in question. The last time he'd been in this module that storage had been filled with audiovisual equipment. Who the hell had made that switch, and why?

A bang reverberated through the module with a peculiar sharp resonance, like having one's head in a metal bucket when someone whacked it with a hammer. Hard. Shrieks and screams. The lights dimmed, then came up to about a quarter of their former brilliance. They were on the module's own emergency power. Power from the Habitat had been cut off.

Power wasn't all that had been cut off. Stunned, Van Atta saw the Habitat begin to turn slowly past his viewport. No, it wasn't the Habitat—it was the module that was moving. A generalized "Aaah!" went up from the mob within, as they began to drift toward one wall and pile up there against the gentle acceleration being imparted from without. Van Atta clung convulsively to the handholds by the viewport.

Realization washed over him almost physically, radiating hotly from his chest down his arms, his legs, pounding up through the top of his head as if to burst through his skull.

Betrayed! He was betrayed, betrayed completely and on every level. A spacesuited figure with legs was waving a cheery farewell at the module from beside a gaping hole burned in the side of the Habitat. Van Atta shook with chagrin. *I'll get you, Graf! I'll get you, you double-crossing son-of-a-bitch! You and every one of those four-armed little creeps with you—*

"Calm down, man!" Dr. Yei was saying, having somehow snagged up by his viewport. "What is it?"

He realized he'd been mumbling aloud. He wiped saliva from the corners of his mouth and glared at Yei. "You—you—you *missed* it. You were supposed to be keeping track of everything that's going on with those little monsters, and you totally *missed* it—" He advanced on her, intending he knew not what, slipped from a handhold, swung and skidded down the wall. His blood beat so hard in his ears he was afraid he was having a coronary. He lay a moment with his eyes closed, gasping, temporarily overwhelmed by his emotions. *Control,* he told himself in mortal fear of his imminent self-destruction. *Control, stay in control—and get Graf later. Get him, get them all . . .*

CHAPTER TWELVE

Leo unsuited to the wails of disturbed quaddies.

"What do you mean, we didn't get them all?" he asked, his elation draining away. He had so hoped that his trou-

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bles—or at least the downsider parts of them—would be over with the ignition of the jet cord cutting off Lecture Module C.

"Four of the area supervisors are locked in the vegetable cooler with breath masks and won't come out," reported Sinda from Nutrition.

"And the three crewmen from the shuttle that just docked tried to make it back to their ship," said a yellow-shirted quaddie from Docks & Locks. "We trapped them between two airseal doors, but they've been working on the mechanism and we don't think we can hold them much longer."

"Mr. Wyzak and two of the life-support systems supervisors are, um, tied up in Central Systems. To the wall hand grips," reported another quaddie in yellow, adding nervously, "Mr. Wyzak sure is mad."

"Three of the crèche mothers refused to leave their kids," said an older quaddie girl in pink. "They're all still in the gym with the rest of the little ones. They're pretty upset. Nobody's told them what's going on yet, at least not when I'd left."

"And, um, there's one other person," added red-clad Bobbi from Leo's own welding and joining work gang in a faint tone. "We're not quite sure what to do about him . . ."

"Immobilize him, to start," began Leo wearily. "We'll just have to arrange a life pod to take the stragglers."

"That may not be so easy," said Bobbi.

"You outnumber him, take ten—take twenty—you can be as careful as you like—is he armed?"

"Not exactly," admitted Bobbi, seeming to find her lower fingernails objects of new fascination. The quaddie equivalent of foot-shuffling, Leo realized.

"Graf!" boomed an authoritative voice, as the airseals at the end of the worksuit locker room slid open. Dr. Minchenko launched himself across the module to thump to a halt beside Leo, and gave the locker an extra bang with his fist for emphasis. One could not, after all, stomp in free fall. The unused breath mask trailing from his hand bounced and quivered. "What the hell is going on here? There's no bleeding pressurization emergency—" he inhaled vigorously as if to prove his point.

The quaddie girl Kara in the white T-shirt and shorts of Medical trailed him, looking mortified. "Sorry, Leo," she apologized. "I couldn't get him to go."

"Am I to run off to some closet while all my quaddies asphyxiate?" Minchenko demanded indignantly of her. "What do you take me for, girl?"

"Most everybody else did," she offered hesitantly.

"Cowards—scoundrels—*idiots*," he sputtered.

"They followed their computerized emergency instructions," said Leo. "Why didn't you?"

Minchenko glared at him. "Because the whole thing stank. A Habitat-wide pressurization loss should be almost impossible. A whole chain of interlocking accidents would have to occur."

"Such chains do occur, though," said Leo, speaking from wide experience. "They're practically my specialty."

"Just so," purred Minchenko, lidding his eyes. "And that vermin Van

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Atta billed you as his pet engineer when he brought you in. Frankly, I thought —ahem!" he looked only mildly embarrassed, "that you might be his triggerman. The accident seemed so suspiciously convenient just now, from his point of view. Knowing Van Atta, that was practically the first thing I thought of."

"Thanks," snarled Leo.

"I knew Van Atta—I didn't know you." Minchenko paused, and added more mildly, "I still don't. What do you think you're doing?"

"Isn't it obvious?"

"Not entirely, no. Oh, certainly, you can hold out in the Habitat for a few months, cut off from Rodeo—perhaps years, barring counterattacks, if you were conservative and clever enough —but what then? There is no public opinion to come to your rescue here, no audience to grandstand for. It's half-baked, Graf. You've made no provisions for reaching help—"

"We're not asking for help. The quaddies are going to rescue themselves."

"How?" Minchenko's tone scoffed, though his eyes were alight.

"Jump the Habitat. Then keep going."

Even Minchenko was silenced momentarily. "Oh . . ."

Leo finished struggling into his red coveralls, and found the tool he wanted. He pointed the laser-solderer firmly at Minchenko's midsection. It did not appear to be a task he could safely delegate to the quaddies. "And you," he said stiffly, "can go to the Transfer Station in the life pod with the rest of the downsiders. Let's go."

Minchenko barely glanced at the solderer. His lips curled with contempt for the weapon and, Leo felt, its wielder. "Don't be more of an idiot than you can help, Graf. I know they foxed that cretin Curry, so there are still at least fifteen pregnant quaddie girls out there. Not counting the results of unauthorized experiments, which judging from the way the level is dropping in that box of condoms in the unlocked drawer in my office, are becoming significant."

Kara started in guilty dismay, and Minchenko added aside to her, "Why do you think I pointed them out to you, dear? Be that as it may, Graf," he fixed Leo with a stern eye, "if you throw me off what do you plan to do if one of them presents at labor with placenta praevia? Or a post-partum prolapsed uterus? Or any other medical emergency that requires more than a Band-Aid?"

"Well . . . but . . ." Leo was taken aback. He wasn't quite sure what placenta praevia was, but somehow he didn't think it was medical gobbledygook for a hangnail. Not that a precise explanation of the term would do anything to ease the ominous anxiety it engendered in him. Was it something likely to occur, given the alterations of quaddie anatomy? "There is no choice. To stay here is death for every quaddie. To go is a chance—not a guarantee—of life."

"But you need me," argued Minchenko.

"You have to—what?" Leo's tongue stumbled.

"You need me. You can't throw me off." Minchenko's eyes flicked infinitesimally to the solderer.

"Well, huh," Leo choked, "I can't kidnap you, either."

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"Who's asking you to?"

"You are, evidently . . ." he cleared his throat. "Look, I don't think you understand. I'm taking this Habitat out, and we're not coming back, not ever. We're going out as far as we can go, beyond every inhabited world. It's a one-way ticket."

"I'm relieved. At first I thought you were going to try something stupid."

Leo found his emotions churning, a mixture of suspicion, jealousy? And a sharp rising anticipation—what a *relief* it would be, not to have to carry it all alone. . . . "You sure?"

"They're *my* quaddies . . ." Minchenko's hands clenched, opened. "Daryl's and mine. I don't think you half-understand what a job we did. What a *good* job, developing these people. They're finely adapted to their environment. Superior in every way. Thirty-five years work—am I to let some total stranger drag them off across the galaxy to who-knows-what fate? Besides, GalacTech was going to retire me next year."

"You'll lose your pension," Leo pointed out. "Maybe your freedom—possibly your life."

Minchenko snorted. "Not much of that left."

Not true, Leo thought. The bioscientist possessed enormous life, over three-quarters of a century of accumulation. When this man died, a universe of specialized knowledge would be extinguished. Angels would weep for the loss. Unless—"Could you train quaddie doctors?"

"It's a foregone conclusion *you* couldn't." Minchenko ran his hands through his clipped white hair in a gesture part exasperation, part pleading.

Leo glanced around at the anxiously hovering quaddies, listening in—listening in while men with legs decided their fate, again. Not right . . . the words popped out of his mouth before reasoned caution could stop them. "What do you kids think?"

A ragged but immediate chorus of assent for Minchenko—relief in their eyes, too. Minchenko's familiar authority would clearly be an immense comfort to them, as they traveled further into the unknown. Leo was suddenly put in mind of the way the universe had changed to a stranger place the day his father had died. *Just because we're adults doesn't automatically mean we can save you . . .* But this was a discovery each quaddie would have to make in their own time. He took a deep breath. "All right . . ." How could one suddenly feel a hundred kilos lighter when already weightless? Placenta praevia, God.

Minchenko did not react with immediate pleasure. "There's just one thing," he began, arranging his features in a humble smile quite horribly out of place on his face.

What's he sweating for now? Leo wondered, suspicions renewed. "What?"

"Madame Minchenko."

"Who?"

"My wife. I have to get her."

"I didn't—realize you were married. Where is she?"

"Downside. On Rodeo."

"Hell . . ." Leo suppressed an urge to start tearing out the remains of his hair.

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Pramod, listening, reminded, "Tony's down there too."

"I know, I know—and I promised Claire—I don't know how we're going to work this . . ."

Minchenko was waiting, his expression intense—not a man used to begging. Only his eyes pleaded. Leo was moved. "We'll try. We'll try. That's all I can promise."

Minchenko nodded, dignified.

"How's Madame Minchenko going to feel about all this, anyway?"

"She's loathed Rodeo for twenty-five years," Minchenko promised—somewhat airily, Leo thought. "She'll be delighted to get away." Minchenko didn't add *I hope* aloud, but Leo heard it anyway.

"All right. Well, we've still got to round up these stragglers and get rid of them. . . ." Leo wondered wistfully if it was possible to drop dead painlessly from an anxiety attack. He led his little troop from the locker room.

Claire flew from hand-grip to hand-grip along the branching corridors, done with patience at last. Her heart sang with anticipation. The airseal doors to the raucous gym were crowded with quaddies, and she had to restrain herself from forcibly elbowing them out of her way. One of her old dormitory mates, in the pink T-shirt and shorts of crèche duty, recognized her with a grin and reached out with a lower hand to pull her through the mob.

"The littlest ones are by Door C," said her dorm mate. "I've been expecting you . . ." After a quick visual check to be sure her flight plan didn't violently intersect anyone else's taking a similar shortcut, her dorm mate helped her launch herself in that direction by the most direct route, across the diameter of the big chamber.

The buxom figure in pink coveralls Claire sought was practically buried in a swarm of excited, frightened, chattering, crying five year olds. Claire felt a twinge of real guilt, that it had been judged too dangerous to their secrecy to warn the younger quaddies in advance of the great changes about to sweep over them. *The little ones didn't get a vote, either,* she thought.

Andy was tethered to Mama Nilla, weeping miserably. Mama Nilla was desperately trying to pacify him with a squeeze bottle of formula with one hand while holding a reddening gauze pad to the forehead of a crying five-year-old with the other. Two or three more clung for comfort to her legs as she tried to verbally direct the efforts of a sixth to help a seventh who had torn open a package of protein chips too wide and accidently allowed the contents to spill into the air. Through it all her calm familiar drawl was only slightly more compressed than usual, until she saw Claire approaching. "Oh, dear," she said in a weak voice.

"Andy!" Claire cried.

His head swiveled toward her, and he launched himself away from Mama Nilla with frantic swimming motions, only to fetch up at the end of his tether and rebound back to the crèche mother's side. At this point he began screaming in true earnest. As if by resonance, the bleeding boy started crying harder too.

Claire braked by the wall and closed in on them.

"Claire, honey, I'm sorry," said

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Mama Nilla, twitching her hips around to eclipse Andy, "but I can't let you have him. Mr. Van Atta said he'd fire me on the spot, twenty years or no twenty years—and God knows who they'd get then—there's so few I can really trust to have their heads screwed on right—" Andy interrupted her by launching himself again; he batted the proffered bottle violently out of her hand and it spun away, a few drops of formula adding tangentially to the general environmental degradation. Claire's hands reached for him.

"—I can't, I really can't—oh, hell, *take* him!" It was the first time Claire had ever heard Mama Nilla swear. She unhooked the tether and her freed left side was instantly set upon by the waiting five-year-olds.

Andy's screams faded at once to a muffled weeping, as his little hands clamped her fiercely. Claire folded him to her with all four arms no less fiercely. He rooted in her shirt—uselessly, she realized. Just holding him might be enough for her, but the reverse was not necessarily true. She nuzzled in his scant hair, delighting in the clean baby smell of him, tender sculptured ears, translucent skin, fine eyelashes, every part of his wriggling body. She wiped his nose happily with the edge of her blue shirt.

"It's Claire," she overheard one of the five year olds explaining knowledgeably to another. "She's a real mommy." She glanced up to catch them gravely inspecting her; they giggled. She grinned back. A seven-year-old from an adjoining group had retrieved the bottle, and hung about watching Andy with interest.

The cut on the little quaddie's forehead having clotted enough, Mama Nilla was at last able to carry on a conversation. "You don't happen to know where Mr. Van Atta is, do you?" she asked Claire worriedly.

"Gone," said Claire joyously, "gone forever! *We're* taking over."

Mama Nilla blinked. "Claire, they won't let you . . ."

"We have help." She nodded across the gym, where Leo in his red coveralls caught her eye—he must have just arrived. With him was another legged figure in white coveralls. What was Dr. Minchenko still doing here? A sudden fear twinged through her. Had they failed to clear the Habitat of downsiders after all? For the first time it occured to her to question Mama Nilla's presence. "Why didn't you go to your safe zone?" Claire asked her.

"Don't be silly, dear. Oh, Dr. Minchenko!" Mama Nilla waved to him. "Over here!"

The two downsider men, lacking the free flying confidence of the quaddies, crossed the chamber via a rope net hung across a farther arc, and made their way toward Mama Nilla's group.

"I've got one here who needs some biotic glue," Mama Nilla, hugging the cut quaddie, said to Dr. Minchenko as soon as he drew near enough to hear. "What's going on? Is it safe to take them back to the crèche modules yet?"

"It's safe," replied Leo, "but you're going to have to come with me, Ms. Villanova."

"I don't leave my kids till my relief arrives," said Mama Nilla tartly, "and nine-tenths of the department seems to

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have evaporated, including my department head."

Leo frowned. "Have you had your briefing from Dr. Yei yet?"

"No."

"They were saving the best for last," said Dr. Minchenko grimly, "for obvious reasons." He turned to the crèche mother. "GalacTech has just terminated the Cay Project, Liz. Without even consulting me!" Bluntly, he outlined the termination scenario for her. "I was writing up protests, but Graf here beat me to it. Rather more effectively, I suspect. The inmates are taking over the asylum. He thinks he can convert the Habitat into a colony ship. I think . . . I choose to believe he can."

"You mean you're responsible for this mess?" Mama Nilla glared at Leo, and looked around, clearly stunned. "I thought Claire was babbling . . ." The other two downsider crèche mothers had come over during the explanation, and hung in the air looking equally nonplussed. "GalacTech's not *giving* you the Habitat . . . are they?" Mama Nilla asked Leo faintly.

"No, Ms. Villanova," said Leo patiently. "We are stealing it. Now, I wouldn't ask you to get involved in anything illegal, so if you'll just follow me to the life pod—"

Mama Nilla stared around the gym. A few groups of youngsters were already being herded out by some older quaddies. "But these kids can't handle all these kids!"

"They're going to have to," said Leo.

"No, no—I don't think you have the foggiest idea how labor-intensive this department is!"

"He doesn't," confirmed Dr. Minchenko, rubbing his lips thoughtfully with a forefinger.

"There's *no choice*," said Leo through his teeth. "Now kids, let go of Ms. Villanova," he addressed the quaddies clutching her. "She has to leave."

"No!" said the one wrapped around her left knee. "She's gotta read our stories after lunch, she *promised*." The one with the cut began crying again. Another one tugged her left sleeve and whispered loudly, "Mama Nilla! I gotta go to the toilet!"

Leo ran his hands through his hair, unclenched them with a visible effort. "I need to be suited up and Outside *right now*, lady, I don't have *time* to argue. All of you," his glare took in the other two crèche mothers "move it!"

Mama Nilla's eyes glinted. She held out her left arm with the quaddie attached, blue eyes peering frightenedly at Leo around Mama Nilla's sturdy bicep. "Are you going to take this little girl to the bathroom, then?"

The quaddie girl and Leo stared at each other in equal horror. "Certainly not," the engineer choked. He looked around. "Another quaddie will. Claire . . .?"

After a barracuda-like investigation, Andy chose this moment to begin wailing protests at the lack of expected milk from his mother's breasts. Claire tried to soothe him, patting his back; she felt like crying herself for his disappointment.

"I don't suppose," Dr. Minchenko interjected mildly, "that you would care to come along with us, Liz? There would be no going back, of course."

"Us?" Mama Nilla regarded him

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sharply. "Are you going along with this nonsense?"

"I rather think so."

"That's all right, then." She nodded.

"But you can't—" Leo began.

"Graf," Dr. Minchenko said, "did your little depressurization drama just now give these ladies any reason to think they were still going to have air to breathe if they stayed with their quaddies?"

"It shouldn't have," said Leo.

"I didn't even think about it," said one of the crèche mothers, looking suddenly dismayed.

"I did," said the other, frowning at Leo.

"I knew there were emergency air supplies in the gym module," said Mama Nilla, "it's in the regular drill, after all. The whole department ought to have come here."

"I diverted 'em," said Leo shortly.

"The whole department should have told you to go screw yourself," Mama Nilla added evenly. "Allow me to speak for the absent." She smiled icily at the engineer.

One of the crèche mothers addressed Mama Nilla in distress. "But I can't come with you. My husband works downside!"

"Nobody's asking you to!" roared Leo.

The other crèche mother, ignoring him, added to Mama Nilla, "I'm sorry. I'm sorry, Liz, I just can't. It's just too much."

"Yes, exactly." Leo's hand hesitated over a lump in his coveralls, abandoned it, and switched to trying to herd them all along with broad arm-waving gestures.

"It's all right girls, I understand," Mama Nilla soothed their evident anxiety. "I'll stay and hold the fort, I guess. Got nobody waiting for this old body, after all," she laughed. It was a little forced.

"Will you take over the department, then?" Dr. Minchenko confirmed with Mama Nilla. "Keep it going any way you can—come to me when you can't."

She nodded, looking withdrawn, as if the bottomless complexity of the task before her was just beginning to dawn.

Dr. Minchenko took charge of the quaddie boy with the still-oozing cut on his forehead; Leo at last successfully pried loose the other two downsider women, saying, "Come *on*. I have to go empty the vegetable cooler next."

"With all this going on, what is he doing spending time cleaning out a refrigerator?" Mama Nilla muttered under her breath. "Madness . . ."

"Mama Nilla, I gotta go *now*," the little quaddie wrapped all her arms tightly around her torso by way of emphasis, and Mama Nilla perforce broke away.

Andy was still wailing his indignant disappointment in intermittent bursts.

"Hey, little fellow," Dr. Minchenko paused to address him, "that's no way to talk to your mama . . ."

"No milk," explained Claire. Glumly, feeling dreadfully inadequate, she offered him the bottle, which he batted away. When she attempted to detach him momentarily in order to dive after it, he wrapped himself around her arm and screamed frantically. One of the five-year-olds twisted up and put all four of his hands over his ears, pointedly.

"Come with us to the infirmary,"

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said Dr. Minchenko with an understanding smile. "I think I have something that will fix that problem. Unless you want to wean him now, which I don't recommend."

"Oh, please," said Claire hopefully.

"It will take a couple of days to get your systems interlocked again," he warned, "the biofeedback lag time being what it is. But I haven't had a chance to examine you two since I came up anyway . . ."

Claire floated after him with gratitude. Even Andy stopped crying.

Pramod hadn't been joking about the clamps, Leo thought with a sigh, as he studied the fused lump of metal before him. He punched up the specs on the computer board floating beside him, a bit slowly and clumsily with his pressure-gloved hands. This particular insulated pipe conducted sewage. Unglamorous, but a mistake here could be just as much a disaster as any other.

And a lot messier, Leo thought with a grim grin. He glanced up at Bobbi and Pramod hovering at the ready beside him in their silvery worksuits; five other quaddie work teams were visible along the Habitat's surface, and a pusher jockeyed into position nearby. Rodeo's sunlit crescent wheeled in the background. Well, they must certainly be the galaxy's most expensive plumbers.

The mess of variously-coded pipes and tubing before him formed the umbilical connections between one module and the next, shielded by an outer casing from microdust pitting and other hazards. The task at hand was to realign the modules in uniform longitudinal bundles to withstand acceleration. Each bundle, strapped together like the cargo pods, would form a sturdy, self-supporting, balanced mass, at least in terms of the relatively low thrusts Leo was contemplating. Just like driving a team of yoked hippopotamuses. But realigning the modules entailed realigning all their connections, and there were lots and lots and *lots* of connections.

A movement caught the corner of Leo's eye. Pramod's helmet followed the tilt of Leo's.

"There they go," Pramod remarked. Both triumph and regret mingled in his voice.

The life pod with the last remnant of downsiders aboard fled silently into the void, a flash of light winking off a port even as it shrank from sight around Rodeo's curvature. That was it, then, for the legged ones, bar himself, Dr. Minchenko, Mama Nilla, and a slightly demented young supervisor waving a spanner they'd pried out of a duct who declared his violent love for a quaddie girl in Airsystems Maintenance and refused to be budged. If he came to his senses by the time they reached Orient IV, Leo decided, they could drop him off. Meantime it was a choice between shooting him or putting him to work. Leo had eyed the spanner, and put him to work.

Time. The seconds seemed to wriggle over Leo's skin like bugs, beneath his suit. The remnant group of evicted downsiders must soon catch up with the bewildered first batch and start comparing notes. It wouldn't be long after that, Leo judged, that GalacTech must start making its counter-moves. It didn't take an engineer to see a thousand ways in which the Habitat was vulnerable.

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The only option left to the quaddies now was speedy flight.

Phlegmatic calm, Leo reminded himself, was the key to getting out of this alive. Remember that. He turned his attention back to the job at hand. "All right, Bobbi, Pramod, let's do it. Get ready with the emergency shut-offs on both ends, and we'll get this monster horsed around . . ." ■

CONCLUDED IN NEXT ISSUE

IN TIMES TO COME

● Next month we have the conclusion of Lois McMaster Bujold's *Falling Free,* and it again gets the cover. There's a cover Vincent di Fate felt compelled to do as soon as he met the quaddies, but couldn't do for the first installment because it would give too much away too soon. But it will work just fine with the conclusion and I think you'll find that the novel well deserves a second cover.

The fact article, "Laughing All the Way to Orbit," is about space travel, but the emphasis is not on the usual sorts of technical problems. Those, after all, are not really the biggest obstacles standing between Us and Out There. Knowing how to build a machine that will do a job does little good unless you can get somebody interested in spending the necessary money to build it. *That's* the sort of problem G. Harry Stine and Wilfred C. Smith address in their article.

The rest of the February issue offers a diversity of stories from such folk as Christopher Anvil, J. Brian Clarke, Steven Gould, and Rick Cook.

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Probability Zero

SURFACED TENSION

Arlan Andrews

"Don't tell *me* the goddamned whales are intelligent!" Admiral Dailey exploded at the shocked woman reporter. He waved a uniformed arm toward the gigantic humpbacked whale that lay in its death throes on the San Francisco beach, fighting off efforts of a dozen crewmen who were attempting to drag the creature back into the surf. "Looks to me like they are just plain stupid!" he fumed, and set off to direct his men and women in the fine art of cetacean retrieval.

A bearded and blue-jeaned young man approached the open-mouthed reporter and offered support. "Mizz . . . Peoples, is it?" A quick smile showed him his effort was well received. "I'm Kris Anson, of Cetacean Research, Inc. If you're convinced that we do share this planet with wonderful and mysterious intelligences like our friend over there—" he pointed at the thrashing whale and the cursing crewmen who were losing their fateful tug-of-war "—then I'd like to talk to you. Privately. Tonight." Raised eyebrows and a deep breath gave assent.

They were having drinks at a seaside restaurant at Fisherman's Wharf as the sun was setting, and in the background a woman's laughter tinkled like the ice in their glasses. "So, Mizz Peoples —Mandy—I've got a scoop for you. My group has been active in cetacean retrievals for the past decade. We've had a few successes, you know." She nodded; she'd heard of the Orcas and the big Blues that CRI had saved.

"Well, our results are based on research that we did on several of the whales that beached on the Massachusetts coast some years back. We did

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acoustical analyses of whale songs and played them back to the surfaced whales and simultaneously, back undersea." The reporter nodded; the incident had got a lot of publicity at the time. But Anson didn't seem satisfied; he kept explaining in more detail.

"You don't understand," he said slowly, "our underwater acoustic transducers, hooked up to our computer system, let the whales underwater and on land communicate with each other. They talked among themselves! Some of the beached ones actually saved themselves!"

She hadn't understood; she could not accept what he was saying. Humans had enabled whales to speak to each other? Whales had understood human communications?

"We think we were able to save some other whales in Alaska by transmitting acoustic signals that they understood." He smiled at her open-mouthed reaction. "Just simple instructions, so far. 'Shallow water,' 'back up,' 'danger,' 'thrash backwards,' things like that. We've been able to decode many of the basic whale signals. So far, we don't know enough to interpret what kinds of details they are transmitting when they sing." He looked at his wrist chronometer. "But in a day or two we should have figured out the translation algorithm and then we can listen to them as they talk to each other." He paused, then said softly, "In the sea and on land." He observed the reporter's reaction.

"You still don't understand, Mizz Peoples," Anson said. "Undersea, the whales communicate by acoustic signals; they 'sing.' The transmission characteristics of the water carry their 'songs' thousands of miles. Once on land they can't communicate back to their fellows in the sea. But, with our system, the acoustic transmitters and transducers, they can communicate anywhere. We can even talk to them when they're beached."

Five days later several whales were spotted heading into San Francisco Bay. Anticipating another beaching attempt, the CRI crew, headed by Kris Anson, set up their receiving stations. The technicians were receiving acoustic signals, as usual, but this time they were also trying to transmit underwater to the whales. If and when a beaching occurred, they'd at least be able to let the whales communicate with each other, maybe save some of them. At best? At best they'd finally crack the translation with the new algorithms, and finally establish real communication with the cetaceans!

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Mandy Peoples stood by, taping every word, every action at the CRI installation as the historic event unfolded.

"We've got a signal, Mandy!" Anson shouted as a wake broke the still surface. "It's coming right at us!" In awe the humans watched a tremendous tail jump by an enormous humpback whale, no more than a thousand feet from shore. The entire length of the whale emerged from the surface and then the creature fell back into the water, a joyous display of determination and control. Underwater acoustic signal strength faded, then surged as the fantastic animal fell back into its natural element. Resubmerged, the whale headed full speed at the beach.

In what seemed like slow motion to the humans, the creature plowed into the rocky beach and thrashed its way onto the shore, painfully inching forward, struggling as if to gain any tiny extra distance. It roared, bellows of a deep voice, a beautifully plaintive song of—what?

"Mandy, come here! The acoustic signal! It's coming right from our friend, right here! It's—it's—" Anson broke off, a wide grin splitting his face. "Oh my god! They're more advanced than we thought! We didn't give them enough time! We've just misunderstood!" In excitement, the scientist tore off his headset and ran over toward the giant mammal, pounding its hide in joyous laughter. Mandy Peoples picked up the discarded headset and listened.

Through the whistles and crackles of the natural whale language, she could hear the computer's dry intonation translating the messages from the whales at sea and from the newest land arrival.

In rhythm to the beached whale's cries, Mandy heard the computer translation: "Our scientists were right—the alien signals brought me safely in! There's no fade-out like before; they're allowing us to talk! I see some of the little guys coming up here now!"

"*Ceeteeceech*, we copy you up," the distant voice said. "You sure they don't have harpoons?"

The beached whale voice responded, "Negative. No weapons, but the little aliens are indeed as ugly as the reports said." The computer voice tone brightened. "Say, guys, it sure is beautiful up here!"

And then, as if in an afterthought, Mandy heard the gigantic mammal add, "Oh, yeah, let's keep this great moment official: Deepbase, Skybase here. The Skybuster has landed." ■

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John E. Carr

State of the Art

THE LAST CAVALIER: H. BEAM PIPER

"For all his knowledge, Beam was no dry intellectual. He was a storyteller; a man who could keep you up all night with his books and his tales. He had respect for the intellect and for intellectuals, but he was never one of the breed.

He was a cavalier."

Jerry Pournelle

On the weekend of November 6th, 1964 H. Beam Piper shut off the utilities in his apartment at 330 East Third Street in Williamsport, Pennsylvania, placed painter's drop cloths over the walls and floor, and shot himself with a .38-caliber pistol. Marvin N. Katz, a reporter for Grit Publishing, stated in the *Analog* letter column that there was a suicide note, but it did not give any reasons for the fatal decision. In a typically Piperesque comment, he did state: "I don't like to leave messes when I go away, but if I could have cleaned up any of this mess, I wouldn't be going away. H. Beam Piper."

Any time an important artist or writer's work is brought to a premature end by death, those who love his work suffer the most tragic loss of all. At the time of his unexpected suicide Piper was writing at the top of his form, classic novels such as *Space Viking*, *Little Fuzzy*, *Cosmic Computer*, and *Lord Kalvan of Otherwhen*, which is why his death has become one of the true tragedies of science fiction. Not that the SF field has been immune to tragedy; Stanley G. Weinbaum, who died at the age of thirty-six after a sudden and meteoric rise, and Cyril Kornbluth, whose prodigious talents were brought to an untimely end by a heart attack at age thirty-five, are two that come instantly to mind. But tragic as these unexpected deaths were, they lack the tragic irony of Piper's suicide, brought about by his mistaken belief that his career was over.

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only a few years before the big SF boom of the sixties would transform science fiction into a cultural icon and in another decade make millionaires out of its top practitioners.

Jerry Pournelle believes that Piper (had he maintained the quality of his early sixties work) would now be ranked among the top dozen SF writers in the field and would have shared their economic success along with their growing literary reputations. As Lester del Rey noted in his June 1976 *Analog* book review column "Piper was rapidly becoming the best adventure writer in science fiction before his tragic death . . ." In his "Paean to Piper" Dwight Decker gives us this interesting alternative view of Piper's career: "I have a feeling that the tragedy of H. Beam Piper is that he started too late. Ten years earlier and he would have been around for John Campbell's *Astounding* revolution and the explosion of talent that introduced Heinlein, de Camp, del Rey, Asimov, and so many others. If Piper had been in that wave, established a decade sooner, he could have developed into a major figure in his own right and have been far more successful by 1964 and not have felt honor-bound to end his own life."

There are even a few skeptics who still believe that Piper's suicide was a cover-up for murder; a murder that echoed Piper's own locked-room mystery, *Murder in the Gunroom*, too closely to be mere coincidence. In *Murder in the Gunroom* Lane Fleming, a noted collector of early pistols and revolvers (much like Piper's friend and mentor Colonel Henry W. Shoemaker, who had a valuable gun collection Piper had cataloged in 1927, and to whom the book was dedicated) was found dead on the floor of his locked gunroom with a Confederate-made .36-caliber revolver in his hand. That suicide was made to look like "death by accident" until Piper's detective Jefferson Davis Rand proved otherwise.

Just what were the events leading to H. Beam Piper's death and was it really a suicide? I fully intend to answer that question here and further illuminate Piper's life and career with new information I've recently obtained from Mike Knerr, one of Piper's Williamsport friends and part-time secretary, Paul M. Schuchart, Piper's schoolmate and lifelong friend, and the H. Beam Piper/John Campbell correspondence which Perry Chapdelaine has so graciously allowed me to review. Along the way, I will attempt to answer some of the other questions that have long bothered Piper scholars and fans: Was Piper really his own man or just a John Campbell hired gun who wrote what he was told? Did the death of his agent, Kenneth White, play the pivotal role in Piper's suicide it has been assigned? Finally, what was the true state of Piper's affairs at the time of his death?

H. Beam Piper was born in 1904 and his father was not a minister as it has been previously recorded by myself, in my introduction to the short story collection *Federation*, and by others. According to Paul Schuchart, a lifelong friend of Piper's: "Beam's father was NOT a Presbyterian minister. His father was a Presbyterian, but worked for the electric company. My father was a Methodist minister at Llyswen, a suburb

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of Altoona, and we lived about a half block from where Beam and his mother and father lived."

In Piper's own words he acquired an excellent education in history and basic science "without subjecting myself to the ridiculous misery of four years in the uncomfortable confines of a raccoon coat." Paul Schuchart adds: "I agree with you when you said Beam never had a formal education, but probably read more books than most professors. I graduated from Washington and Lee in Lexington. My recollection is that Beam was thrown out of the Altoona High School, because he shot the bottoms out of several test tubes in the chemical lab."

We know Piper had a lifelong fascination with both firearms and writing. Besides cataloging his friend Colonel Shoemaker's extensive gun collection, Piper had a large one of his own with over a hundred antique and modern weapons and accessories, some of which he fashioned himself such as a powder horn listed in the Shoemaker catalogue. According to the September 1953 issue of *Pennsy Magazine*, Piper's weapon collection ranged "from a four hundred-and-fifty-year-old French sword and a four-hundred-year-old Spanish poniard with a gold inlaid blade to a small brass cannon once mounted on a pioneer's blockhouse during the Indian fighting and a nine-millimeter pistol of the type used by German SS troops in World War II."

Piper put a great deal of his knowledge of warfare and weaponry into *Age of the Arquebus* (the lost historical novel Piper was writing about the life of Gonzalo de Córdoba) and his last and maybe best novel, *Lord Kalvan of Otherwhen*. Paul Schuchart gave the following rememberance of Piper's fondness for gunpowder hardware: "He (Piper) came down some time later to accompany me to Washington to see the inauguration of Roosevelt as President. He came downstairs with a big hand gun, telling me he always carried a gun. I told him, regardless of whatever he always did, there would be no gun in his possession for that event. Beam couldn't understand that, but he was willing to trust his gun not to my wife, but rather to the girls, and we went on our way." Even when facing destitution during the last year of his life, Piper still refused to sell his gun collection (by that time worth a good deal of money) and instead shot pigeons off his window sill rather than part with his precious firearms.

As with his passion for weapons, Piper's love affair with writing was lifelong. John H. Costello in "H. Beam Piper: An Infinity of Worlds" tells us "at eighteen, he went to work as a laborer for the Pennsy, having been a veteran of rejection slips for two years. He continued to work for the railroad well after he became a selling author." Piper corroborates this in his dedication to his 1953 mystery, *Mystery in the Gunroom:* "To Colonel Henry W. Shoemaker—an old and valued friend, who was promised this dedication, with an entirely different novel in mind, twenty-two years ago"

Whatever special formula it took for Piper to become a published writer, he didn't discover it until he was forty-two-years-old and sold his first story, "Time and Time Again," to John W. Campbell. After this first sale, which ap-

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peared in the April 1947 issue, Piper was a regular contributor to *Astounding/Analog* for the remainder of his life. Besides *Astounding*, which was his primary market, Piper was published in *Weird Tales, Future Science Fiction, Amazing, Fantastic Universe*, and *Space Science Fiction* during the early fifties.

Probably the best description of Piper's own view of his sf writing at this time is in these words from *Murder in the Gunroom* made by Pierre Jarret—a science fiction writer and confidant to the protagonist, Jeff Rand—in answer to the question "What are you writing?"

> "Science Fiction. I do a lot of stories for the pulps . . . *Space-Trails*, and *Other Worlds*, and *Wonder Stories:* mags like that. Most of it's standardized formula-stuff; what's known in the trade as space-operas. My best stuff goes to *Astonishing* (a barely disguised Astounding—jfc). Parenthetically, you mustn't judge any of these magazines by their names. It seems to be a convention to use hyperbolic names for science fiction magazines; a heritage from what might be called an earlier and ruder day. What I do for *Astonishing* is really hard work, and I enjoy it. I'm working now on one of them, based on J.W. Dunne's time-theories (Piper's own Paratime series was based on one of Dunne's time theories—jfc), if you know what they are."

This is an interesting assessment of early fifties science fiction magazines and a rare look at Piper's view of his own writing. During this period Piper was working full time for the Pennsylvania Railroad at Altoona as a railroad detective and, while not wealthy, was not writing out of financial need. While he did write two detective novels (the second Jeff Rand mystery *Murder Frozen Over* never sold), it was obvious that science fiction was his first love and he took writing it seriously.

Piper's most important writing relationship was the one he had with the legendary John W. Campbell, the editor who bought Piper's first and last stories. Just what was Piper's relationship with John Campbell?

In Mike Ashley's analysis of the Analytic Lab, in his *Complete Index to Astounding/Analog*, Piper ranked third in overall cumulative Analytic Lab voting behind C.L. Moore and number one vote getter, Robert A. Heinlein. Of all the many important *Astounding* writers it could be said that the early Heinlein and Piper most epitomized Campbell's philosophies in their writings. Piper researcher John Costello says: "Into his (Piper's) stories he put a great deal of philosophy—of the Campbellian sort . . . Piper was a 19th Century Liberal, a creature with whom neither conservatives nor libertarians can be completely comfortable; and like their creator, he (Piper) did not believe that anyone had a right to automatic sustenance. Throughout his career, he remained a 19th Century Liberal and a Citizen in the Campbellian sense—quite firmly dedicated to the ideal of Civilization and individual self-reliance."

In many ways H. Beam Piper epitomized Campbell's *Citizen*: "The fully developed Citizen actually seems to be every bit as hard-headed, ruthless, and

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dangerous a fighter as any barbarian—he just uses his ruthless determination wisely instead of egocentrically." The Piper hero, best described in "Oomphel in the Sky," is a person who "actually knows what has to be done and how to do it, without holding a dozen conferences and round-table discussions and giving everybody a fair and equal chance to foul things up for him." This is a fair description of Pappy Jack from *Little Fuzzy*, Lord Kalvan, Conn Maxwell of Cosmic Computer, Campbell's Citizen and—for that matter—Piper himself.

Jerry Pournelle describes Piper as a "courtly gentleman, soft-spoken but determined, quiet, somewhat melancholy, but with a dry wit and self-reliant to an extreme." Often at conventions Beam would be sitting in a corner by himself or totally wrapped up in a conversation about politics or history with a fellow writer and a bottle of Jim Beam. Marvin Katz in his *Analog* obituary adds the following reminiscence: "At first reticent, even shy, Mr. Piper warmed to the conversation quickly once he felt at ease. He proved a charming, gracious man, soft-spoken and witty, perceptive in his comments."

Yet, because Piper and Campbell thought along similar lines and many of Piper's themes were similar to Campbell's, some critics have speculated that Piper wrote his stories to editorial order. Not true. While most of the Piper/Campbell letters could be classified as pleasant and mutually respectful, it's obvious from their tone and words that Piper was no "yes man."

In a 1951 letter, where Piper is discussing the pros and cons of dealing with agented story submissions, he says: "I'm afraid, though, that your (Campbell's) suggested solution would do more harm than good, by angering authors; it could easily be reflected in authors' instructions to agents: 'Send it to anybody but that s.o.b. at *Astounding*.' Another solution, that of refusing to buy from anybody but agents, would result in shutting off the manuscripts from new authors—if you'd had a policy like that in 1946, I'd never have gotten published anywhere. It would leave you with a dwindling staff of old-timers, while the new writers were all going to Sam Merwin or Horace Gold."

Here we see that while Piper is respectful of Campbell's feelings, he's not afraid to be the bearer of bad news—even if it's to the man who made it possible for him to become a writer. Piper, then still working for the *Pennsy*, even makes light of his economic dependence upon Campbell in his closing to the same letter: "Sorry I can't think of an answer that wouldn't cost money, or lay me open to the accusation of scheming to bore a hole in Street & Smith's moneybox to my own advantage and enrichment."

In regards to their editor/author relationship, it's quite apparent from Campbell's letters that he had a good deal of respect for Piper's work even if he didn't buy everything Piper sent him. This June 5, 1962 letter says it best:

"Dear Mr. Piper:

> I don't know what plans you have for a next story project, but the world-picture you've been building up in the Sword World stories, or Space Viking stories, or whatever you designate the series (TerroHuman Future History—jfc),

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offers some lovely possibilities. *Space Viking* itself is, I think, one of the classics—a yarn that will be cited, years hence, as one of the science-fiction classics. It's got solid philosophy for the mature thinker, and bang-bang-chop-'em-up action for the space-pirate fans. As a truly good yarn should have.

"One of the beauties of the set-up you've got is that it allows the exploration of cultures of almost all conceivable levels of complexity and technology. They can be examined either internally or externally—i.e., either by a native, or by a visitor."

Campbell goes on with one of his legendary three page story synopses —interestingly enough, one that Piper never used. In an earlier letter to Piper's agent, Kenneth White, Campbell says: "Beam Piper's 'Slave' ('Slave is a Slave') yarn is a lovely thing; he's got some lovely lines in it—and some very sound philosophical points . . ."

Campbell was not so enamored of Piper's work that he bought everything Piper wrote, as shown in the letters by his rejection of two of Piper's novels, *Four Day Planet* and *Little Fuzzy*. Campbell rejected *Little Fuzzy*, unarguably Piper's most popular book, in 1959, three years before it was finally published by Avon Books: "The thesis of this one is one that I'm keenly interested in, but I feel that you've somewhat ducked the central issue which you established. That is, the 'talk and build a fire' rule is shown to be no proper test; in the end you have the Fuzzy's speech picked up and understood . . . I feel this novel isn't as strong as it could have been. You, in your detective experience, found that life is in fact made up of a most awful confusion of too many people who might be involved. You must have learned how to mentally juggle two dozen relevant characters at once in your work. The average reader hasn't . . . the problem has some tendency to get lost, strayed, or forgotten under the deluge of characters."

Campbell was rarely wrong in judging his audience, but it's clear from the popular success and Hugo nomination of *Little Fuzzy* that he underestimated the story. Yet, from his conversations with Jerry Pournelle and others, it's clear that Piper shared Campbell's assessment of *Little Fuzzy* and no one was more surprised—maybe even dismayed at first!—than Piper when it became a top contender for the 1962 Best Novel Hugo Award.

Even up to the end, when Piper wrote this September 5, 1964 letter to Campbell with the submission of "Hos Hostigos," the third Kalvan novella, Piper maintained his independence from editorial meddling and a clear view of his own vision:

"This penicillin suggestion; this is the very last thing Kalvan would want to do. He doesn't want to shift Styphon's House into a new racket, he wants to smash it. As it stands, with a monopoly on gunpowder, they control the princes. But if he gets them working miraculous cures, he'd give them a popular following, which they don't have.

I know, you like victories by slick tricks, but slick tricks run out, sooner or later, and in any case

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they're good odds-cutters and that's all. The best answer to slick-trickery is always a fast punch in the nose. The Japanese tried that heroin trick in China, before the formal beginnings of World War II, when Chiang Kai-Shek was in control. His answer to it was to kill all the heroin peddlers *and all the heroin addicts*, he could. Nothing like a hundred-odd grains of copper-jacketed lead injected at six or eight hundred fps [feet per second] at the base of the brain to cure anything.

Of course, if Chiang had been a nice humanitarian type, it might have worked, but he wasn't.

So if Kalvan wants to destroy Styphon's House, and destruction is the only thing he can do about it, and wants to maintain his new Great Kingdom, he'll have to do it where it counts, on the battlefield. He can, and will, soften them up by all sorts of slick tricks; he can start them fighting among themselves—see what happened to Prince Gormoth, in this story—but when they're softened up enough, the troops will have to move in and finish it. As long as soldiers don't let statesmen, professional slick-trickers, squander their victories at the peace conference, that settles it.''

It's clear from the Piper/Campbell correspondence that Campbell both liked Piper and considered him among his top writers for *Astounding/Analog* during the fifties and early sixties. It's also obvious that Piper was no mere Campbell clone, but a man with his own vision—influenced by Campbell, but clearly an independent thinker and writer. A self-reliant man, who—if anything—took his self-reliance just a bit too far.

As in this reminiscence by Paul Schuchart, ''One time, before I got married in 1929, Beam was asked by the Episcopal Bishop of the Harrisburg Diocese to mark the Appalachian Trail from the western side of the Susquehanna River to the Maryland State line, sleeping on the Trail and making like a real 'outdoor' man. Wanting to help Beam and in the event he might run into some snakes, I got him a bottle of Good Bourbon. Those were the days when I had a bachelor apartment on North 3rd Street in Harrisburg, consisting of a living room, bedroom and a bath, with a long bathtub, not a shower. When Beam got back, with about half of the bottle left, he was soaking in the tub. What he had left just about filled a water glass. About that time, the girl—who kept the place 'clean'—came. Beam didn't like the idea of being 'inspected' lying in the tub by any girl. The girl told Beam 'not to worry' about that and to Beam's disgust, after carrying that bourbon miles and miles, the girl drank all that whiskey. He never forgave that girl and waited until I got married and lived in a house before he showed up again.''

Being the private and solitary man that he was, Schuchart was quite surprised when he turned up with a wife. ''That Beam ever married-up surprised me.'' Piper was reticent about his late marriage and probably helped contribute to the 'stories' that she was a French Woman and married him for an expensive Parisian vacation that have become part of the Piper legend.

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Mike Knerr, who's in possession of Piper's diaries, says: "Piper was not married to a French woman. Her name was, or perhaps still is, Elizabeth Hirst of Carmel, California, but she spoke fluent French and worked for the Council of Student Travel in New York. They were married on Friday, March 25, 1955, with Inga Pratt as witness—and she did not marry him to gain a Paris vacation." So much for legends!

The marriage did not last long, which is not surprising seeing that it was Piper's first marriage and he was fifty-one years old at the time. It was probably not helped by Piper's very wry sense of humor. Schuchart tells the following story: "The next to the last time I saw Beam was in New York. I was there to attend some kind of a meeting and called Beam. It was when he was having problems with his wife; all because he had got his wife's dog drunk on "very dry" martinis, served in a dish . . . Beam and I had a few drinks before the evening was over. I do not remember meeting his wife."

Piper published very little science fiction between the years 1952 and 1956, only one short story, "The Return," and two short novels. In part this was due to the breakdown in national magazine distribution and increasing competition from television of many of the sf magazines Piper had been writing for in the early fifties. This left Piper with fewer markets in 1956 when he found himself without a job, a small pension, and a wife to support.

Piper did not, as erroneously reported by myself and others, leave his job with the railroad because of the death of his invalid mother. Mike Knerr reports: "The death of his mother did *not* allow him to retire—he didn't support her, since Harriet Piper had her own money. Beam was bounced from the railroad because of the cutbacks the Pennsy and the Reading railroads suffered in the mid-fifties.

Piper moved to New York City, where his wife was working, and began to write full time for the first time. John Costello says: "Nearing sixty, he embarked on a disastrous marriage. An expensive European honeymoon, and subsequent divorce proceedings, wiped out his life's savings and left him, in the words of Lester del Rey, 'with hardly enough money to put bread on the table.' "

In 1957 Piper published two short stories, one novella, and a short novel, *Lone Star Planet*. Although Piper's output had increased significantly from the previous few years, he was hardly publishing enough fiction to support himself, much less a wife. In 1958 he only published one short story, "Graveyard of Dreams," and one novella, "Ministry of Disturbance." Just three short stories appeared in 1959, while in 1960 his only publication was "Oomphel in the Sky" in *Analog*. It was during this bleak period his marriage dissolved and he returned from New York to his native Pennsylvania.

Marvin Katz, the *Grit* reporter, states: "He had several friends in Williamsport at that time and his gun collection (which had been loaned to the Lycoming Historical Society Museum) was in the city, so he settled here." We know Piper was working hard during these years because Campbell rejected *Little Fuzzy* in May of 1959 and bounced both

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Four-Day Planet and "When In the Course . . ." in 1960. It must have been very discouraging during those lean years and one wonders how Piper survived them.

The late fifties and early sixties were a bad time for the majority of SF writers; the magazine market had slimmed down to about six major magazines and there were only two or three publishers of SF novels. Yet, a writer could support himself for a year on the sale of one or two novels so it's not surprising Piper spent most of his time writing novels in the early sixties. In 1961 G.P. Putnam's published *Four-Day Planet* in hardcover and *Little Fuzzy* was printed at long last by Avon in 1962. *Space Viking* was serialized in *Analog*, starting in November 1962 and running through February of 1963; it was novelized later in '63 by Ace Books along with *Junkyard Planet* (Piper's title was *Cosmic Computer*—jfc).

Thanks to the unexpected success of *Little Fuzzy* and his other sales, for a while Piper thought his financial problems were solved. But this Indian summer was not to last for long. Avon requested a sequel to *Little Fuzzy* and he was able to sell the movie rights for a tidy sum, although it was not so easy collecting the money. In a December 1963 letter to Charles and Marcia Brown, Piper wrote: "I certainly will make the London trip in '65, if still alive and solvent then. I finally got the first advance on the picture rights for *Little Fuzzy*, six months after signing the contracts, due largely to the persistance of Ken White. I'm afraid that is all, no mention of a production date." In June of 1964, he adds in another letter to the Browns: "I haven't heard any more from the movie than Jim Blish has from his. Do we have an extradition treaty with Jamaica and the Bahamas? If not, that could just be the reason."

Piper finished the sequel to *Little Fuzzy* in the spring of 1963 and Avon proceeded to publish it the following year in a manner guaranteeing that it would never earn out even its advance. They changed the title from *Fuzzy Sapiens* to *The Other Human Race*—a move that insured that only Piper's staunchest fans would recognize it as *Little Fuzzy*'s sequel—and gave it the murkiest purple cover in paperback history. Naturally, it bombed. When told by the Browns that it was out in paperback, Piper replied in June of 1964: "Haven't seen a copy of what they call *The Other Human Race*, which I suppose is *Fuzzy Sapiens*. Thank you for letting me know. I don't suppose they bothered to tell Ken White, either. I question if he'll be any more amused about this than I am."

Unfortunately, the publishing pipeline being what it is (it takes somewhere between eight months and two years for a completed manuscript to become a paperback novel.) Piper had already finished *Fuzzies and Other People* before *The Other Human Race* was published. In the middle of 1963 he'd written: ". . . I have just had a letter from my agent telling me that Avon wants a sequel to the sequel of *Little Fuzzy*." When the third Fuzzy novel was completed and turned into Avon it was promptly bounced as part of an unsuccessful series; of course, look what they'd done to *Fuzzy Sapiens!*

The book was obviously not

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Campbell's cup of tea so Piper sent it to Fred Pohl at *Galaxy*. Fred Pohl, Piper's former agent, rejected it (unaware of the desperate state of Piper's finances) as too derivative, which it was for *Galaxy* since neither of the earlier books had been run there either. Not receiving the second half of the *Fuzzies and Other People* advance and being unable to sell it elsewhere certainly contributed to Piper's growing depression and the belief that his career was coming to a close. It's a sad day for any writer when a book that has been commissioned and written is returned for any reason. For Piper, it may have been the kiss of death.

Piper had already turned away from working on his historical novel about the life of Gonzalo de Córdoba to write *Fuzzies and Other People*. "It (*Age of the Arquebus*—jfc) is now shelved, however, since I have just had a letter from my agent telling me that Avon wants a sequel to the sequel to *Little Fuzzy*, and I want that finished and accepted as soon as possible, so the arquebus has been hung up temporarily." Unfortunately, Piper never returned to his historical novel, in a letter Mike Knerr states: "There were about thirty-odd pages written on *Age of the Arquebus* that I saw some weeks prior to Beam's death, but they did not surface when we cleaned up the apartment. A lot of things were missing at that time—among them 'Piper's History of the Future' and I think he might have burned them. I don't know for sure."

We know that the lackluster response to *The Other Human Race* and Piper's inability to sell *Fuzzies and Other People* were a large part of the reason for his growing despondency. The only other writing project Piper was working on in 1964 was the Lord Kalvan series. The first story, "Gunpowder God," was submitted to Campbell on April 13, 1964. Campbell liked the series ("This is a lovely yarn . . .") but he wanted major revisions: "We got troubles . . . The situation is we've got novels on hand and already scheduled through August 1965 . . . and I can't run both a 25,000 word novel installment and a 25,000 word novelette . . . If Beam can cut this to 18,500, I'll give him the full 4¢ bonus rate on acceptance."

Campbell liked the Lord Kalvan series and responded within days to Piper's submissions. In his May 1964 acceptance letter for "Gunpowder God" Campbell writes:

> "Your yarn, as shortened, is fine; check on the way.
>
> Your suggestion for further yarns along the path you've sketched out is also fine. I'm definitely looking for stories with a bit more guts to them than the stuff that's standard in American Literature these days . . .
>
> Your Aryan-Transpacific paratime line allows of some grand yarns, with men who are damn well MEN, and women who aren't afraid to be different from men, and like it that way. It's a world where insurance hasn't been invented, and every individual is very acutely and personally responsible for his own acts and behavior—which, as Bob Heinlein pointed out in *Beyond This Horizon* breeds a race having good manners, clear thinking, and fast reflexes!"

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By this time, with no other projects in the fire, Piper was living from check to check. And, while it was no doubt gratifying to receive Campbell's praise, it was just as frustrating to have to rewrite each submission. In his June 15, 1964 letter, after a lengthy and friendly discussion about his journey to Scotland (it's obvious that Campbell knew nothing at this time of Piper's financial difficulties), Campbell tells Piper: " 'Down Styphon!' come back for some minor revisions. . . . I know it's hard to see that staff meeting is "a dry lecture by the author" when *you* know how important the data is to the story. Yeah . . . *you* do. But does the reader who wants a good old-fashioned swashbuckler? No, he does not. He resents your 'stopping the story to spout hypothetical history.' Can something be done about this—and a couple of similar scenes—in this yarn?" Campbell goes on with a possible idea for another story.

Piper's reply is prompt and interesting, considering it's only five months before his death. " 'Down Styphon!' II (version number 2—jfc) is done, and off to Ken White; you should be getting it along with this . . . I got rid of most of the indigestible chunks of tactics, such as the proper employment of cavalry, why cavalry are better off without lances and musketoons, the precise differences, including weight and caliber, between an arquebus and a caliver, and how many of the militia still had crossbows . . .

"The Bengali story's a good one; I may use that, not for a Paratime story but for a Future History story, either Terran Federation or Galactic Empire, probably the latter . . ." It's obvious from these comments that Piper hadn't given up hope for the future, yet . . . On September 5, 1964 Piper sent Campbell "Hos-Hostigos," the third, and by far longest, of the Lord Kalvan stories: "Here's the third of the Kalvan stories. The original idea was that Kalvan should make his father-in-law, Prince Ptosphes, Great King; for reasons set forth in the body of the story, this didn't seem such a good idea, and Kalvan, as you will see, becomes Great King himself. Now, I am pretty much like Ike Asimov trying to figure out where to put the Second Foundation. Kalvan is Great King, and Hos-Hostigos is really beginning to pick up *Hos-* power, but Styphon's House isn't down yet, let alone out, and the great King of Hos-Harphax isn't going to take this secession from his realm placidly. To carry on the story further, I'm going to have to do a lot of figuring . . ."

Here we have Piper full of plans for more Kalvan stories and he sounds, at least, peppy, if not cheerful. What happened to so suddenly plunge him into a suicidal depression?

First, it must be remembered that Piper had a morbid fascination with his own death which runs through almost all of his correspondence. Furthermore, the early sixties was a volatile period for world affairs as well; it was the era of nuclear brinksmanship; the Nixon-Khrushchev Kitchen Debates, the Berlin Crisis, the Cuban Missile Crisis, the Bay of Pigs . . . The so-called Cold War was as hot as it's been since or before, and Piper—the great student of history that he was—took it very seriously. In a 1963 letter to Jerry Pournelle, Piper wrote: "You know, it must

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have been lovely, living in an era when the Clausewitzian 'extension of politics by other means' was accomplished with nothing more lethal or expensive, especially expensive, than black powder."

Later that year, Piper wrote to Charles and Marcia Brown: "You will undoubtedly see me at the Discon, if we are all alive by then, and Washington hasn't been H-bombed in the meantime." Then in December 1963 he wrote: "I certainly will make the London trip in '65, if still alive and solvent then."

But it took the death of Piper's longtime agent and friend Kenneth White to finally tip the scales. In a letter dated October 13, 1964—less than a month before his death—to John Campbell, Piper wrote:

Dear John:

I was informed yesterday of the death of my agent and good friend, Kenneth White, ten days ago. I had not heard from him for some time previous—I understand he had been ill for several months—and do not even know if he received the manuscript of the third of the Lord Kalvan stories or sent it on to you. This story is entitled "Hos-Hostigos." I would much appreciate your letting me know whether you received it, and if so what you've decided about it.

I have made arrangements by telephone with Mr. Max Wilkinson, of Littauer & Wilkinson, to represent me in the future. Agents are replaceable; friends aren't.

Nice cover for "Gunpowder God," but who told the artist that Pennsylvania State cops wear blue? They don't, they wear gray. And the red keystone doesn't belong, that's 28th Division, PNG. Otherwise, splendid!

Yours truly,
Beam

Campbell replied on October 19, 1964: "Your letter telling about Kenneth White's death came as a shock. I hadn't heard. 'Hos-Hostigos' was returned to Kenneth on September 16th with a letter." Campbell further expands on this in a letter, from *The John W. Campbell Letters: Volume I*, to John D. Clark: "We bought the first and second Lord Kalvan stories from Piper, through his agent Ken White. 'Hos-Hostigos,' the third, was submitted by Ken White, and I sent it back for some revision with an eight page letter of explanation.

"Three months later, I heard from Piper that Ken White had died suddenly, leaving his affairs in such a mess that nobody had been informed and nobody knew what to do, and nobody had done anything for a couple of months. So Piper didn't know what I'd said about 'Hos-Hostigos,' and never got my letter. And I, by then, didn't remember the yarn exactly enough to be able to redo the letter without seeing the manuscript. So Beam was broke, and apparently decided to go out sidewise . . . suicidewise."

This is further corroborated by Piper's follow-up letter of October 26, about a week before his death: "I had a telephone conversation with Mr. Max Wilkinson, inquiring if he would be willing to take over as my agent. To this he agreed, but since then I have heard noth-

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ing from him, although some report on the state of my affairs in Ken's hands at the time of his death seems rather overdue. Now I don't know whether I have an agent or not, and until I hear something positive to that effect, I'll have to act on the assumption that I don't.

"For one thing, I have not received the letter which you sent accompanying the return of 'Hos-Hostigos,' and except for your brief note, know nothing about it . . . Do you want a revision on the story? If so, I would be deeply grateful if you would write me, giving me a resumé of the letter which accompanied it back to Ken, and telling me what needs to be fixed up about it. If you would do so, I will get to work on it immediately."

This was Piper's last letter to Campbell and closed with the formal, "Yours Cordially, H. Beam Piper." Piper, already dejected by Avon's and *Galaxy*'s rejection of *Fuzzies and Other People*, saw the disappearance of Campbell's extensive rewrite letter as one of the last straws. The cold shoulder from his new agent (who during this time had sold all three Kalvan novellas to Ace Books as *Lord Kalvan of Otherwhen*—without telling Piper or Campbell!—as the novel version appeared in print before "Down Styphon!," much to Campbell's chagrin) helped to convince Piper that his days as a selling author were just about over.

Piper's final diary entries, provided by Mike Knerr, read:

"October 17, 1964—Quite sleepless at 2200, and read until 0600—*Murder Frozen Over*, the Jeff Rand story I never could sell. This is carrying it about as far as I ever have.

November 4, 1964—Up 0930. Worked until mid-PM on planning. Out 1600 for a little, read in evening; defeat; Goldwater carried Arizona and a few of the Deep South states; Johnson everything else, including Maine and Vermont. The only thing that will save this country now is an Act of God, and God doesn't exist."

Piper's last diary entry is on November 5th. Mike Kneer comments: "He didn't kill himself on November 9, since the State Police notified me on November 8 and the last entry in his diary is for November 5. It reads: 'Rain 0930. Up 0900.' The only entry in pencil. I didn't see any drop cloths—just a pool of dried blood on the desk and a .38 caliber hole in the ceiling."

Piper, John Costello writes, was "pretty much a loner—and, as a very lonely man approaching late middle age, filled with horror that he might end the responsibility of someone else." Piper told no one—not even his closest friends—of the severity of his financial affairs. Jerry Pournelle, a Senior Scientist at Boeing at the time, had he known would have gladly lent Piper "whatever he needed. Beam was my mentor." Mike Knerr writes: "It didn't have to happen. Hell, I'd have supported him, had I known. Beam and Ray Bradbury taught me to write and that has to count for something."

Was there any conspiracy involved in Piper's death? I do not believe so; the evidence presented here is straightforward and conclusive. Jerry Pournelle says: "When I first heard the news of Beam's suicide, I was heartsick. I just knew there was more to it than suicide;

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Piper owned a valuable gun collection and a number of people knew it and wanted it bad enough to kill for it.

"I immediately called the Williamsport Police Department and spoke with the investigating officer, a Captain Lawrence P. Smeak. He told me all the evidence pointed to Beam having taken his own life because of severe financial difficulties. Then Captain Smeak read me the suicide note. It was pure Piper. I was convinced."

I believe that H. Beam Piper—his funds dwindling, literary records in chaos, deserted by his new agent, despondent over the future of his country, and faced with an uncertain personal and financial future—killed himself rather than going on public assistance. He was a local celebrity. Marvin Katz, in his *Analog* obituary says it best: "In the months to come (after meeting Piper—jfc), my wife and I wanted to invite him to dinner but were frankly intimidated at the thought of disturbing him. An internationally famous writer, you know . . .

"Now we realize we should have taken the initiative and asked him, but hindsight will always show the clear path that was formerly covered over. Personally, I suspect that loneliness may have been as important a factor in the final tragedy as any other consideration." During my research, I contacted John Piper (no relation) in Altoona, who had just completed a local history, and he referred to Piper as "one of Altoona's literary lights."

I don't think Piper wanted to face the public humiliation of what he saw were his alternatives to suicide. He was too self-reliant and proud to ask assistance from his friends. Selling his gun collection was out of the question, since that would have required asking for its return from the Lycoming Historical Society Museum. To go on public relief in a town where Piper was not only well-known but a local celebrity, must have been too painful to consider. In the end, suicide must have appeared to offer the only way out of the "mess" he was in.

It is our tragic loss, for we know the man and his works the less because of it. ■

●Just in our galaxy, perhaps one civilization comes into being every year—at least, one star is formed per year. But other solar systems leave the scene, blow themselves up, or otherwise disappear, with about the same frequency.

Dr. Frank D. Drake

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the reference library

By Tom Easton

The Jehovah Contract, Victor Koman, Franklin Watts, $16.95, 277 pp.
The Final Planet, Andrew Greeley, Warner Books, $16.95, 302 pp.
Forest of the Night, Marti Steussy, Ballantine/Del Rey, $2.95, 272 pp.
Stepfather Bank, D. C. Poyer, St. Martin's, $16.95, 288 pp.
The Urth of the New Sun, Gene Wolfe, TOR, $17.95, 384 pp.
Universe 17, Terry Carr, Doubleday, $12.95, 180 pp.
The 1987 Annual World's Best SF, Donald A. Wollheim, DAW, $3.95, 303 pp.
Ray Bradbury, David Mogen, Twayne (G.K. Hall), $17.95, xiv + 186 pp.
Science Fiction and Fantasy Reference Index, 1878-1985 (2 vols.), H. W. Hall, ed., Gale Research, $175.00, 1,460 pp.
Twentieth Century Science Fiction Writers, 2nd Edition, Curtis G. Smith (editor), St. James Press, $67.50, 933 pp. *Reviewed by Stanley Schmidt*

Column 98. Number 100 is coming up Real Soon Now, and the other day the American Legion (no, I don't belong) invited me to volunteer a couple of hours as "The Electric Swami" with my fortune-telling computer program. Unfortunately, the day of their fund-raiser comes a week *after* the deadline for that column. If it came a week before, I could probably convince myself that there is enough similarity between fortune telling and book reviewing—both are mystic arts which only the Enlightened are permitted to practice—to turn the occasion into a nice theme for my centenary.

As things stand, let's stick with business as usual. This month, that begins with Victor Koman's **The Jehovah Contract.** And that begins as Dell Ammo, free-lance assassin and private eye, receives a visit from a TV evangelist who carries a whiff of Old Nick. And yes, I'm writing this in the spring of 1987, while the Pass The Loot folks

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are still big in the headlines. And no, I'm not making this up. And no, I didn't give Koman a copy of my computer program a year or so ago, when *he* was making it up.

What does the evangelist want? Very simply, he wants Ammo to go after the Big Guy Himself, to assassinate God. And Ammo, chump that he is, thinking the evangelist is a chump, sure that God is a figment, says, "Why not?" And then the fun begins. Somebody wants Ammo dead. But he persists in his task, with the aid of a lovely gal who may or may not be a steal from an old movie (her name rings faint bells) and is certainly connected with the Old Religion. Before long, he has a telepathic whore for a sidekick, arouses the wrath of a conspiracy of thearchs, stirs up what seems to be a divine counterattack in the form of bloody mass hallucinations, and learns a little more about that evangelist's BO. He garners clues from a witch's seance. He spends a lot of time in the library, doping out his target and giving Koman ample opportunity to lecture on how much religion does not make sense.

In the end, Ammo discovers precisely what God really is, and how to kill Him. And then he combines high technology and ancient witchery to defeat what we—with Koman—can only call Big Daddy and restore the triune Big Momma to the throne.

The publisher bills the book as bound to arouse controversy. I doubt that it will, for despite Koman's comments upon theology, the book is not serious enough to be read in circles whose members are likely to get mad. It is light adventure, the philosophy little more than a pseudointellectual—though nifty—hook intended to get the reader past the unoriginal setting (a decaying 1999 Los Angeles), the derivative character stereotypes, and the stock action—rats and bats in the subways, and gunships in the air.

I wonder why anyone should even think it controversial. *The Jehovah Contract* is sacrilegious, yes, but sacrilege is cheap these days. And it will get cheaper. Some time back, I predicted that we would see more and more millennial fiction—concerned with the Second Coming, or the end of the world, or the death of God—over the next two decades. It was a safe prediction, and I'm pleased to have been right, but I wish I weren't. Millennialism shows signs of becoming not just a trend, but a flood, and we will all be heartily sick of it long before the year 2000. For those of us who are not, we will have to define a new genre, with its own magazines and bookstore racks, right beside the horror section.

For all of you—whatever your ancestry—with a bit of the Irish within you, there is Andrew Greeley's latest, **The Final Planet.** It is just as millennial as Koman's book, but as one might expect from a scholar, priest, and certified intellectual, considerably less obvious about it. The religion is there, and the death of a world, or rather a culture, but there is no question of a Second Coming or the death of God, and the date is too far in the distant future to be tied to any particular millennium.

The background: Some time in the future, there will be a second Irish diaspora, and those marvelous blatherskites will settle the worlds of Tara, Cork, and so on. At roughly the same time, the non-Irish will also leave Earth to settle such worlds as Zylong. But it is the Irish civilization that Greeley shows us as successful, based in Catholicism and Celtic culture. One feature of this civilization lends itself particularly well to

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fiction, for the Gaels of Tara go on pilgrimage, boarding monastery ships like the *Iona,* presided over by the Holy Captain Abbess Deirdre Cardinal Fitzgerald and protected by Wild Geese space marines (named for expatriate Irish soldiers of fortune), to seek a new world to settle. If that new world is already occupied, they can land only by invitation. Once down, they can set up a matter-transmitter link back to Tara.

The *Iona* is on its last legs when it reaches Zylong, a world that seems about to collapse in anarchy. Centered in a single city, it is ruled by secret oligarchs, dominated by highly repressed sexuality, at war with factions at its heart and with exiles in the jungles beyond the city walls. It does not seem about to invite outsiders to join it. But the *Iona* must land or die. It sends Wild Goose Seamus O'Neil as a spy to feel out the Zylongi and, with luck, get them to invite the *Iona* down.

As an Irishman, Seamus is of course a horny fellow, and he promptly falls in love with at least two of the local women. One, Marjetta, is the "proper woman" he craves for a wife, and once she rescues him from drowning they get on famously, if with plenty of sparks. Seamus falls in with rebels, the secret oligarchs take steps to remove him, and the plot begins to move.

The tale's conclusion is predictable, but don't let that stop you from enjoying it. Greeley's characters are marvelous, and marvelously Irish, and—I realize as I mull the tale to prepare this review—he has something interesting to say. Zylong stands for the Church, based in the Eternal City, Rome, ruled by oligarchs, repressing sexuality, and at war with factions within and without. The Irish are the joyous forces of life that threaten the Church with salvation. And Greeley's point seems to be that the Church, like Zylong, will let itself be saved only over its dead body.

Would you like a quibble? Greeley is not a biologist: At one point, he refers to Earth's pre-Cambrian forests, and in pre-Cambrian times, there were no such things. In fact, there was no life on land to speak of.

Marti Steussy is an ordained minister working toward a doctorate in Hebrew Bible. We might thus expect her first novel, **Forest of the Night,** to have something in common with the Koman and Greeley books. But it doesn't. At least this time out, Steussy leaves religion alone.

Steussy's heroine, Hashti, is a journeyman horse-trainer under contract to help a corporation's employees harvest timber from an unsettled planet. But the logging expedition is underequipped, and Hashti and the members of the First-In team who have lingered as consultants soon suspect that the corporation intends to enslave Hashti and the other employees by debt to the company store. Fortunately, there are local animals, tigers, that are making pests of themselves by pouncing on the loggers. They do no real harm, though they are frightening, and Hashti chases one off by punching it in the nose. But then a logger shoots one, a tiger kills the logger in apparent retaliation, and the logging crew begins to run scared. At the same time, the pelt of the dead tiger proves to be a stunningly luxurious fur that just might make an export item of high enough value to foil the company's economic tyranny.

Do you need to know that one tiger seems to be trying to talk to Hashti in order to predict the rest of the story? That Hashti quickly catches on, that the First-In crew hints that she might make a better First-Inner than a horse-trainer,

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that she heads into the wilderness to gather proof of the tigers' sentience, and that she succeeds?

I suspect that Steussy, like many of us, cut her teeth on Andre Norton's novels and that she had them in mind when she tackled *Forest*. The signs show in multi-species exploration crews, close human-animal relationships, mystery sentients, and more. Sadly, Steussy doesn't yet have Norton's panache or skill at characterization. Both may come when she begins to tell her own stories, for she writes cleanly and directly and—to use a reviewer's cliché—shows promise, especially in her elaboration of a cat's pouncing into a crucial plot gimmick.

According to D. C. Poyer, a writer of much more panache and imagination than most, the future holds nuclear winter as the Great Overcast, governmental collapse, and salvation in the person of genius polymath Gnath Greatmother, inventor of para-electronics, artificial sentience, and a host of other technological marvels. But by 2110, Greatmother is long dead and the ultimate merger of all the world's corporations and governments into the Bank, centered on a computer personality formed around the mind of an ancient science fiction writer, has owned the world for four generations. Economics is all. Everyone works for the Bank and buys from the Bank, which assigns jobs, homes, mates, children, and—when one's balance is overdrawn—Termination.

A nightmare? Most of the world's citizens seem happy enough, for they are healthy, fed, educated, housed, employed. But one citizen is not. Monaghan Burlew, the semiliterate last of the con-men, swore at his majority not to play the Bank's games. He does not work and is not paid. He buys nothing. He is a parasite, but he cannot be Terminated, for his balance is zero, not negative.

Burlew is also a poet of superlative awfulness, and his "pomes" stimulate the world's citizens to think: Here is Burlew, awful, fat, smelly, ignorant, but free and mocking their master. They too begin to mock, and the Bank's Directors, their lives extended endlessly by the fruits of Termination, vow to rid themselves of the sole thorn in their side. They send a woman to bait him into debt. She succeeds, but she also tells Burlew all and runs with him to stir up still more trouble and, ultimately, bring the system crashing down.

And it is all necessary to save the world. Burlew chose his path because as an adolescent he dreamed of the end of the world. The Bank *knows* the end of the world is coming and has its own plans, originally set in motion by Greatmother herself. But those plans need help, and the Bank, a plotter worthy of its SF writer template, must take independent steps. By the time it resurrects Burlew and tells him of the threat to Earth which only he can hope to stop, we are wondering just how independent those steps have been, and how far-reaching, for we would not put it past the Bank to use its super-computer psi talents to lead Burlew to the world's salvation.

Don't miss. You'll enjoy it, even though you may not catch Poyer's Grimm joke about the wicked *real* mother that explains the title, **Stepfather Bank**.

I deliberately have not used Gene Wolfe's **The Urth of the New Sun** to open this column. Yes, this book, this capstone for the *Book of the New Sun*, is a publishing event, in capital letters

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and with asterisks. It is an occasion for ballyhoo and hype and vast enthusiasm. But it doesn't need any of that puffery. You read and loved and raved about the *Book*. Here's *Urth*, and it would take teams of wild horses to keep you away from the bookstore.

For those who need reminding, Wolfe's saga of the far distant future concerns Severian, apprentice to the Guild of Torturers, and his progress through a world of marvels to become the Autarch, lord of the Commonwealth and titular head of Urth (our renamed planet). I only hint at Wolfe's achievement when I say that he gives us a world where the weight of ages is palpable—in the strata of the mountains, the districts of the city, the immensity of the Autarch's library, the layered complexity of ritual, the fading of the sun itself—but a world that is also constantly fresh, discovered through Severian's young eyes.

Severian ages. His eyes and joy lose youth. Urth grows stale. And then Severian gains the opportunity he has known awaited him, to voyage into space on vast ships that literally sail the tides of time, to be tested for his fitness to save Urth from the dying of its sun to become, in fact, the New Sun itself.

No, he doesn't blaze forth as a star. But he does become linked in some way to a white hole, which travels toward Urth to fuse with the sun and cancel out the black hole at its heart. He gains stellar power, to heal and destroy and walk the pathways of time. He regains his youthful freshness of vision. He becomes, in several ways, his own destiny, and here we may have Wolfe's overall point, that throughout our lives we make and remake ourselves, though we may first have to travel far, even unto the thrones of the angels, to replenish the wellsprings of energy within our souls.

You've heard, haven't you, that *Urth* was supposed to be the end of the story? That may be true, but the book ends on an oddly inconclusive note (as do the episodes of life), and Wolfe is renowned for remaking his plans. Do not be surprised if he sneaks in another volume in a year or so.

Is it the end? Is **Universe 17** the last *Universe?* I expect so, for it was Terry Carr's editorial judgment that made this original anthology good enough to last for nearly twenty volumes, and he is no longer with us. If Doubleday drafts another anthologist to continue the title, it cannot be the same.

Universe 17 is a collection of excellent stories, six of them this time around, and it may well sell better than all its predecessors. The reason is not that it *is* any better, for we have long expected Carr to find future winners of the Hugo and Nebula. What will, I think, account for many sales will be our wish to honor Carr by possessing the last of his works. What will account for many more will be the book's lead story, which we will want in order to honor another writer, Alice (Raccoona) Sheldon, aka James Tiptree, Jr. Just a few days ago, as I write this, she shot herself and her husband, who was suffering from Alzheimer's disease.

Perhaps unfortunately, the juxtaposition of two "last works" in this way is rare enough to make the book a collector's item and may account for the most sales. That may smack of necrophilia, but . . .

On the other hand, death has a strong presence in this book. And it does not seem unfair to suggest that Carr's knowledge of how ill he was influenced his choices of stories. "Mencken Stuff,"

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by Joel Richards, considers how someone cast back in time could thrive on a single remembered fact, and a death at that. The Tiptree novelette, "Second Going" (such a painfully apt title), concerns the visit to Earth of benign aliens with a unique view of godhood and a curious way of handing us Utopia; other hands might have developed it as a novel, and it would still have been a worthy story. Marta Randall's short "Lapidary Nights" is a gem of innocence betrayed, in at least two senses, and of revenge. Cherie Wilkerson's "The Man Who Watched the Glaciers Run" concerns a youth whose pace in time is a seventh of ours, and the love of a woman for him withal. Ned Huston's "Pliny's Commentaries," the slightest tale in the book, and the nearest to a cliché, satirizes humanity's logic and fallibility from the viewpoint of its robotic successors. Jack McDevitt's "In the Tower" shows a much more potent, intuitive hand than did his novel, *The Hercules Text* (an Ace Special and hence also selected by Carr); its weakness lies in the logic of the horror that drives the plot.

Donald A. Wollheim's **1987 Annual World's Best SF** is now available, so let's look at it in the light of my remarks about the Dozois *Best* last month. It's got ten stories, five of them duplicates from the Dozois book (Cadigan's "Pretty Boy Crossover," Shepard's "R&R," Tanith Lee's "Into Gold," Silverberg's "Against Babylon," and Knight's "Strangers on Paradise"). Three of the ten—all three among the duplicates—are from *Asimov's,* too, and while the percentage of *Asimov*ian stories is a little less than in the Dozois book, it is high enough to show that Dozois's biases aren't too blinding; clearly, he's doing a good job with his magazine.

Of the remaining five stories, Dozois gave Honorable Mentions to two: Waldrop's "The Lions Are Asleep This Night," a nice Africa-ascendant alternate history tale, and Zelazny's "Permafrost," a yarn of frozen hearts on a frozen world. The last three—Doris Egan's "Timerider," concerning love and bonding in a far-distant time of alien domination; Suzette Haden Elgin's "Lo, How an Oak E'er Blooming," a marvelous tale of one-up-woman-ship; and Jerry Meredith's and D. E. Smirl's "Dream in a Bottle," of navigation by manipulating the dreams of embottled brains—are Wollheim's unique picks, and he makes no errors. All his stories, like all of Dozois's, are gems; the Meredith/Smirl is the weakest one but that is unavoidable and no discredit for the writers, beginners whose story appeared in *Writers of the Future Volume II.*

Is it a disappointment to find only two stories from *Analog* among the 32 "Best" chosen by Dozois and Wollheim? In a word, yes. You, like me, read this magazine because you enjoy its kind of stories, and you would like to see their quality recognized more often. But don't despair—a good many of the 32 wear their rivets where they show, and presumably they didn't appear in these pages only because their authors sent them elsewhere first. The year 1986 was such a great year for shorter SF that there is no way any one magazine could have held it all.

For years, Twayne Publishers (now a subsidiary of G. K. Hall in Boston) has been publishing its Twayne's United States Authors Series, which reaches its 504th entry with David Mogen's **Ray Bradbury.** Mogen is an "associate professor of English at Colorado State University, where he teaches a variety of courses, including science fiction,

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literature of the American West, and American Indian literature." His other writings have dealt with frontier mythology, and it is thus less than surprising that he should tackle Bradbury, both through the existing literature and through "a two-day marathon interview." He, like others, sees in this popular writer a strong sense of space and the future as new frontiers for humanity.

He also notes Bradbury's widely ranging curiosity, which lead him as child and adult through vast stacks of fiction and nonfiction, feeding his muse with models of excellence and great wads of raw material for associative creativity. What strikes me about Mogen's description of Bradbury is that it could fit many other SF writers, and their readers, and perhaps most of all scientists. All creative people have unusually free-ranging minds, but SF people's and scientists' minds may range more freely and widely, and recognizing this (Mogen doesn't) might provide a clue to why, despite some vigorous debate over whether Bradbury has betrayed SF by his allegiance to a nostalgic view of the future, he truly belongs in the SF camp. He is artist, stylist, humanist, variously technophobic, pessimistic, warning, and celebratory, but he has an SF mind.

The book itself begins with a chapter of biography. It continues with analyses of Bradbury's relations with his critics, the sources and nature of his style, and his work, divided into weird tales, space stories, images of the future, other genres, and detective fiction. *The Martian Chronicles, Fahrenheit 451, Dandelion Wine,* and *Something Wicked This Way Comes* get special treatment. And the end result is an admirable sense of knowing Bradbury and his work better than ever.

* * *

Gale Research has done it again. For just $175, you can have 1,460 pages in the two massive volumes of H. W. Hall's **Science Fiction and Fantasy Reference Index, 1878-1985.**

What is it? Let's quote the opening lines of the preface: It "is by far the most comprehensive index yet published to the secondary literature dealing with science fiction and fantasy. More than 19,000 individual books, articles, essays, news reports, and audiovisual items are indexed by over 42,000 author and subject citations. Although the earliest entry is an 1878 item on Jules Verne, most of the entries date from 1945 through 1985. More than 95 percent of the items were personally examined; citations to the balance are based on secondary sources I judged reliable."

That, by itself, is enough to make the *Index* invaluable to graduate students, scholars, and others researching SF&F topics. In addition, there are a thesaurus of indexing terms and a bibliography, as well as coverage of non-English works, fanzines, and unpublished works in library collections. It isn't perfect, though; the fanzine *Lan's Lantern,* mentioned in the index entries, does not appear in the list of sources.

Hall is the head of the Special Formats Division of the Sterling C. Evans Library at Texas A&M University. He has also done Gale Research's *Science Fiction Book Review Index* and the annual (1980-1984) *Science Fiction and Fantasy Research Index.* Clearly an indefatigably useful fellow.

ANADEMS

Several years ago, Charles Platt published *Dream Makeers* and *Dream Makers II* with Berkley. They drew good reviews but disappeared quickly, as is the way of paperbacks. Now Platt has

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struck a deal with Ungar, and we have a new **Dream Makers,** a long-lived hardbound for $17.95. It contains 25 superlative interviews with major SF authors; the jacket copy claims they are "new and revised profiles," but 18 of the interviewees were covered in the first paperback and 7 in the second, and it would take a close reading to spot any revisions; Platt doesn't help by pinpointing any. There are a new introduction and an afterword revealing what has happened to the interviewees in the years since they were interviewed. Among the interviewees are the late Tiptree, Hubbard, Sturgeon, Dick, and Herbert.

In July 1982, I reviewed John Sladek's **Roderick.** At that time Sladek's tale of a learning-machine robot escaped from the lab to "grow up" among humans came (in the U.S.) in three volumes, I had only the first, and I never did see the next two. Now Carroll & Graf Publishers (260 Fifth Avenue, New York, NY 10001; 212-889-8772) has reissued it as a 350-page paperback at $3.95. I have *Roderick,* which seems to be the first two volumes of the old trilogy; *Roderick at Random* is billed as coming soon.

I respectfully suggest that you don't let either the Platt or Sladek books escape this time around.

Because of its price, probably few individuals will buy the updated **Twentieth Century Science Fiction Writers.** Libraries, however, should consider it obligatory, even if they already have the first edition—which, until now, has been not just a major reference work but the only one of its kind. Many new writers have entered the field since 1981, and older ones have produced important new work. These recent developments are reflected in some 50 new entries, plus more or less extensive revision of old ones. The largest and most important part of the book consists of individual biographies and bibliographies of English-language science fiction writers since 1895. These are accompanied by a signed critical essay on each writer's work. There are also appendices similarly describing foreign authors who have been translated into English, and major writers of fantasy.

The book is not without shortcomings. There are a fair number of typos and some curious omissions—for example, no listings for Nancy Kress, Eric Vinicoff, or Marc Stiegler (even though Stiegler is discussed at some length in the article on Joseph H. Delaney, with whom he collaborated on some but by no means all of his stories). The bibliographies generally list uncollected short stories only if they appeared since the author's last collection, even though many short stories in this field never appear in collections. If a section on fantasy writers is to be included at all, shouldn't it contain more than five entries? The title index to stories listed in the bibliographies is a useful addition to this edition, but the reader should be warned that it apparently lists only novels. The critical essays occasionally suffer from the personal biases and interpretive excesses to which critics are often prone, but that (admittedly almost inevitable) fact is nicely offset by the facts that the essays' authors are clearly identified and living subject authors were invited to provide statements of their own. And the factual content, in most of the cases I spot-checked (no, I didn't read the whole Encyclopedia!), seemed satisfyingly accurate.

It might be nice if the book had some features it lacks, but those are relatively minor quibbles and may be remedied in the next edition. Meanwhile, libraries will need this book, and some others may want it, for what it does have. ■

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brass tacks

Dear Mr. Schmidt,

I read Richard Meisner's recent article on the "Universe as an Artifact" with considerable interest. While I agree in general with his argument, there is one point which seems to require correction.

In his table on the fundamental natural constants (p. 58), he characterizes the four forces as having "dimensionless" magnitudes. However, pure numbers are not dimensionless, but one-dimensional. For instance, the number "3" is 3^1 and the number "n" is n^1. As usual, the dimension of a magnitude is denoted by its exponent. Because pure numbers are one-dimensional, they can be arrayed in a one-dimensional series in which the position of the numeral indicates its value. If this were not so, then we couldn't distinguish the weak force from the strong force or the gravitational force from the electromagnetic force.

Pure numbers are pure quantities, lacking any specified quality. The number "3" may refer to cms, pounds or googols. In general, the numerator indicates quantity, whilst the denominator represents quality. Thus 3/1 is a pure quantity, because the denominator is an unspecified "unity" which may be anything from apples to oranges.

A pure number is the limit of an one-dimensional interval, but this interval only approaches, but never becomes zero. Only zero is "dimensionless."

DR. EDGAR TASCHOJIAN
S. Ozone Park, NY

Not really a correction, but just another case of an English word having two different meanings in different contexts. I won't deny that mathematicians use it as you do, but among physicists the "dimensions" of a quantity are usually understood to mean what you call "quality" (or something very much like it)—e.g., the dimensions of "acceleration" are length/(time^2), and pure numbers are considered "dimensionless."

Dear Stan,

An article appeared in the April '87 *Analog*, "Universe—The Ultimate Artifact?" The basic idea of the article was that the universe seems just right for life to develop; and this was either an *amazing* coincidence, or strong evidence for an ultimate intelligence —maybe even God.

This speculation certainly seems tempting to those of us who share the Christian faith, myself included. However, from a logical point of view, it may be on the order of a garden glove reasoning that God must have created human hands just for the glove's convenience. You see, the glove was made to fit human hands, the same way evolution makes us fit the universe.

The benevolent intelligence theory has been around for a long time. Its champions have stated that the Earth is precisely the correct distance from the sun, that the abundance of water is unlikely, that the ozone layer is a necessity of life. Someone recently remarked to me that "Evolution sure painted a beautiful sunset tonight."

To believe this theory, you must believe that evolution could not cope with any conditions other than those on Earth. And then evolution didn't ac-

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tually even cope with these conditions, that some intelligence had a hand in that, also.

Let me reason through this backwards. We have *strong* evidence that evolution has occurred on this planet, and created the life present on it. We can therefore suppose that given enough time, and a planet that isn't too adverse, that evolution will occur, and will cope with conditions opposed to it. We might suppose that there are some conditions imposed upon ourselves which might be difficult. The ozone layer, for instance. It blocks out ultraviolet light, which we ourselves would find dangerous, but would life itself find dangerous? No, life exists on the energy of sunlight, and this filtering effect could easily be a limiting factor.

Let me go further. Life is based on certain chemicals because *under these conditions* these chemicals show the necessary properties: semi-stability and complexity. Under different conditions different chemicals will have that property.

But this is not the exact issue debated by Mr. Meisner in his article. He debates the presence of stable stars, the presence of hydrogen and carbon, and other such mainstays of life as we know it. He states with authority that if we change this constant or that one that this will happen and this other thing will be made impossible.

We can then assume that, given his understanding of the laws of physics as he knows them now, that he could predict stable stars, and presence of the various elements, as easily as he predicts that there could be none otherwise.

Our understanding of the subject certainly is not that deep. We can't predict what would replace our stars. Any change that would make reaction A impossible could easily make reaction B possible. All we know is that *our* stabilities wouldn't work. Anyone in another, different universe might look at our physical laws, and say "No life can exist here, because they can't have stable scwuggles."

Mr. Meisner also berates multiple universes. Unfortunately his only available criticism of this idea is that "no one really believes in it." If he really cares to address the subject, he should apply himself better than that.

The most surprising thing about the article is that the author is a mathematician. Being one myself, I think he should have realized this. He claimed the lottery was fixed, because the odds were too high for anyone to win without knowing either the odds or the number of players. He is drawing conclusions on the statistical sample of one.

DAVID GRAHAM

Pittsburgh, PA

Dear Stan,

You've got to watch these "new-fangled contraptions" . . . er, computers. Wouldn't you know, the first time I use my new machine to do an article for *this* magazine ("The Curious Case of the Humanoid Face . . . on Mars," *Analog*, November, 1986), it "eats" a couple of important acknowledgements!

It was indeed John Hewitt, then a model-maker and general consultant associated with the "Mars Project," who about a year ago suggested the "interstellar probe" scenario I eventually used to frame the problem of "the Face" and its associated "artifacts." John also reminded me that it was Karl Gauss who first proposed that a *geometric* symbol be constructed somewhere, to alert "the Martians" to intelligence on Earth. The application of this logic to Cydonia, if not its nineteenth century source, was just too apt not to include . . .

As you know, these tidbits (and their inspiration) were dutifully included in

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my (long!) original draft. In making some of the edits you suggested, I realized that some of the material would read better if I separated these ideas from their acknowledgement; I decided (as long as I had a *computer*) to move the latter to the end of the piece . . . which was my first mistake. (Jerry Pournelle once told me that, before he acquired his computer, he was often "just too lazy" to put that "last finishing touch" on a ms; oh, that I had listened . . .) For instead of being moved "at the touch of a button," the acknowledgements (unbeknownst to me)—

Simply disappeared.

As luck would have it, that was the same afternoon I was abruptly called out of town, leaving the way clear for (my second mistake) *someone else* to print out the new, revised ms and mail it to NYC. The rest, you know.

I would like, therefore, to take this opportunity to extend a belated apology to John, and a similar "thank you" to Dan Drasin (who functioned so superbly in my absence, preparing the careful illustrations for the article and taking pains to see that they appeared in their appropriate positions). Both individuals have been important to our continuing efforts to understand Cydonia. And in "Monuments" (my book-length recounting of the past four years of this research) both have been appropriately remembered . . . if only because I've finally "got the hang of this infernal contraption!"

DICK HOAGLAND

Dear Mr. Schmidt,

I imagine that *Analog* has never reprinted a science fiction story, has it? After all, sci fi magazines are dedicated to new fiction, not to anthologizing.

But could *Analog* reprint a ten-year-old story if it served as an effective editorial?

Analog has carried several editorials about Challenger, but none of them have zeroed in on the most important issue of all. Frederik Pohl's "The Mother Trip" is (in my opinion) the one and only proper conclusion for Analog's discussion of Challenger.

WILLLIAM WRIGHT

Goleta, CA

No, we don't do reprints, and I don't think it would be in our best interests to start. However, your letter may inspire some readers to look up Fred's story.

Dear Mr. Schmidt,

I am well aware of your contempt for the social sciences, but you could at least have the common decency to ensure that a story gets its facts straight. I am referring to the story "Conestoga History" by James B. Johnson in the May issue. If an *Analog* story mangled a point of physics the way the author mangles American history in that story, you would receive a flood of letters. You deserve at least one for the ignorance of history shown.

Before I go on, I am perfectly aware that the story is premised on a change in American history in 1796. For the sake of argument, let us even assume that it would be considered appropriate for the federal government in 1796 to investigate a covered wagon accident. Even though few, if any, people at the time would have considered that the government could do such a thing (as late as 1830, Andrew Jackson could get away with vetoing a bill on the premise that the federal government had no constitutional power to build roads), the premise is necessary to the story. I am also fully aware that the story assumes changes in American history as a result of the fictional events of 1796.

Many of the items in the story are

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based on a terribly flawed understanding of U.S. geography in 1796. In the Treaty of Paris in 1783, Great Britain granted independence to more than the original thirteen colonies. The Congress also received power over the Northwest Territory and the Old Southwest. This area included almost all of the United States that is now east of the Mississippi River. The main exception covers the states of Florida and Louisiana, and the Gulf Coast areas of Alabama and Mississippi. Even in the terms of the story, most of this unincluded territory would later become part of the United States as part of the Florida Purchase.

A number of items in the story reflect this error. For example, Elvis Presley, having been born in Mississippi, would still be English-American. Hands Across (English) America would have reached from the Virginia coast to somewhere in Illinois or Kentucky. Other items would clearly be unaffected. One major source of tension between the North and South during the years before the Civil War was whether slavery would be permitted in newly acquired territory. Although other sources of tension existed, it is certainly defensible to assume that no Civil War would have occurred in a non-expanding United States.

One especially glaring error made by Johnson is that he completely ignores pre-1796 history when he calls "Floribama" the fourteenth state. Assuming no changes in American history before 1796 (the beginning of the story), and no new states between 1796 and Floribama's admission, the author still has to explain away Vermont (admitted to the Union in 1791), Kentucky (1792), and Tennessee (1796). Assuming no changes other than those alluded to in the story, he also ignores Ohio (1803), Indiana (1816), Mississippi (1817), Illinois (1818), and Alabama (1819), all of which were formed from the land given up by Great Britain in 1783.

It is not necessary for a good science fiction writer to know American history. It is necessary, however, for an author to know the subject of the story well enough to avoid glaring errors such as the one in "Conestoga History." One of the most common complaints among the scientific community is that the social science/liberal arts community looks down on the sciences. Maybe that attitude would change if the scientific community showed some respect, too.

FRED G. PETRICK, JR.
Carrboro, NC

Caricatures were never meant to be evaluated by the same standards as photographs. This story was a caricature, and you seem to have missed the point.

On the other hand, some things are *meant to be taken very literally. Your claim that you are "well aware" of my "contempt" for the social sciences shows that you haven't been paying as close attention as you might to what I've actually said on that subject.*

Dear Stan;

I realize that the fillers inserted to fill otherwise empty spaces aren't meant to be taken *too* seriously, but since I'm proud to be a cover-to-cover reader —literally—I enjoy reading the fillers, too. However, I have a nit to pick regarding the filler on page 57 of the May '87 issue, which appears to translate the English term "jet lag" into the German "die infolge (sic) der Zeitverschiebungen bei Flugen mit Düsenmaschinen auftretenden Müdigkeitserscheinungen." I realize that Qantas, the attributed source of the item, is probably simply making light fun of what often appears to an anglophone to be the verbose nature of German, but the long German phrase is not the German equivalent of "jet lag," but rather a dictionary definition, in German, of the English phrase.

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A correct equation would substitute an *English* dictionary definition for "jet lag."

Hmm, now that I think of it, I can't say I know how to translate "jet lag" into German. But, then, I don't know how to translate "Kindergarten" or "Weltanschauung" into English. It reminds me of the famous experiment in computer translation where the English phrase, "the spirit is willing but the flesh is weak" was translated into Russian, and then back into English and came out "the vodka is desirous but the meat is rotten"!

MARC A. SCHINDLER
Ontario, CANADA

I hate to disappoint you, but Qantas was not *making fun of German—I was the one who wrote the two phrases in isolation as an equation. The Qantas manual simply* used *those two phrases in one of those situations where the same text (assorted information for passengers) is repeated in several different languages. And that interminable phrase really was how they expressed "jet lag"!*

Dear Dr. Schmidt;

I have been a subscriber of *Analog/Astounding* since 1955 and have been a reader of some variability over these years. Recently I have been doing a pretty good job of covering most of each issue. I'm pleased in general with the type of stories that have been run over the last few years and look forward to each new issue.

However, there is one suggestion I have. There have appeared recently various parts of many informal "serials" such as "The Report on Bilbeis IV," "All Fall Down," and "The Testament of Geoffrey." In each case as I read these stories it reminded me of the other parts of the "serial" that I had read before. As it happened, in all three cases I liked the previous "episodes" and remembered with pleasure reading them. There is a problem with this and that is that my memory is not perfect and I could not remember all of the details of the previous stories that I wanted to. Especially in the case of "The Report on Bilbeis IV" I could only remember part of the details of each of the previous stories. I could remember that I really did like them both, especially the first one. So what I did was look back through previous issues for these stories so I could reread them.

This did not take too long, but it was a bit annoying, and I was aided by the fact that I knew that Harry Turtledove and Eric G. Iverson are one and the same. This leads me to make the suggestion that each story of this sort have a "Bibliography" at the end so one can easily find the previous "episodes." I think this would be very helpful, especially for new readers who might not know of the previous stories. If a new reader liked the story he was reading, he might be pleased to know of other "episodes" in the series. I know this would be very useful for me.

If someone else has suggested this and I have missed it, I apologize since I do not always read Brass Tacks. Keep up the good work and I hope to enjoy another 32 years of Analog.

JAMES C. READING
1298 E. Millbrook Way
Bountiful, UT

I'm sure some readers would like it if we did what you suggest, but others might mistakenly assume that they couldn't read and enjoy the new story if they'd missed others in the series, even though we always try to make sure you can. I'd be interested in hearing other opinions on the proposal. ■

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a calendar of analog upcoming events

1-3 January
UNIVERSE 88 (southern California SF, Fantasy & Gaming Conference) at Airport Hilton & Towers, Los Angeles, Calif. SF plus adventure game tournaments. Registration—$19.50 until 5 December 1987, $25 at the door. Info: Universe 88, % New Century Project, Box 2577, Anaheim CA 92804. (213) 867-4140.

15-17 January
CONFUSION (Ann Arbor area SF conference) at Southfield Hilton, Southfield, Mich. Guest of Honor—Joe Haldeman, Fan Guest of Honor—Larry Tucker, TM—Marta Randall, Artist Guest of Honor—David Cherry. Registration—$15 until 25 November 1987, $20 at the door. Info: AASFA/ConFusion, Box 8284, Ann Arbor MI 48107.

15-17 January
RUSTYCON V (Pacific Northwest fan-oriented SF conference) at Everett Pacific Hotel, Everett, Wash. Guest of Honor—Philip Jose Farmer, Artist Guest of Honor—Steven A. Gallacci, Fan Guest of Honor—Betty Bigelow. Registration—$18 until 31 December 1987, $22 at the door (registration limited to 800). Info: Rustycon V, Box 47132, Seattle WA 98146.

15-17 January
ESOTERICON V (Religion, Occult, SF, Magic conference) at Sheraton Meadowlands Hotel, East Rutherford, N.J. Info: Esotericon V, Box 22775, Newark NJ 07101.

25-28 January
General Meeting of the American Physical Society at Crystal City, Va. Info: A.P.S., 335 East 45th Street, New York, NY 10017.

29-31 January
CHIMERACON V (North Carolina SF conference) at University of North Carolina, Chapel Hill, N.C. Guest of Honor—Nancy Springer. Events include costume workshop and contest. Registration—$12.50 in advance; $6/day, $11/2 days, $15/3 days at the door. Info: ChimeraCon V, 15-A University Gardens, Chapel Hill NC 27514. (919) 933-3003.

29-31 January
BOSKONE XXV (New England Regional SF conference) at Sheraton Tara and Springfield Marriott, Springfield, Mass. Guest of Honor—Greg Bear, Official Artist—David Mattingly, Special Guest—Ellen Asher. Registration—$25 in advance, $40 at the door. Note: attendance is limited to 2,000 by facility space; there is a possibility that no memberships will be generally available at the door. Info: Boskone XXV, Box G, MIT Branch PO, Cambridge MA 02139.

1-5 September 1988
NOLACON II (46th World Science Fiction Convention) at Sheraton Hotel & Towers, Marriott Hotel, Rivergate Convention Center, New Orleans, La. Guest of Honor—Donald A. Wollheim, Fan Guest of Honor—Roger Sims TM—Mike Resnick. Registration—Attending $60 until 31 December 1987, $70 to 10 July 1988. Supporting—$30. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: Nolacon II, 921 Canal Street #831, New Orleans LA 70112 (504) 525-6008.

—Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices six months in advance of the event.

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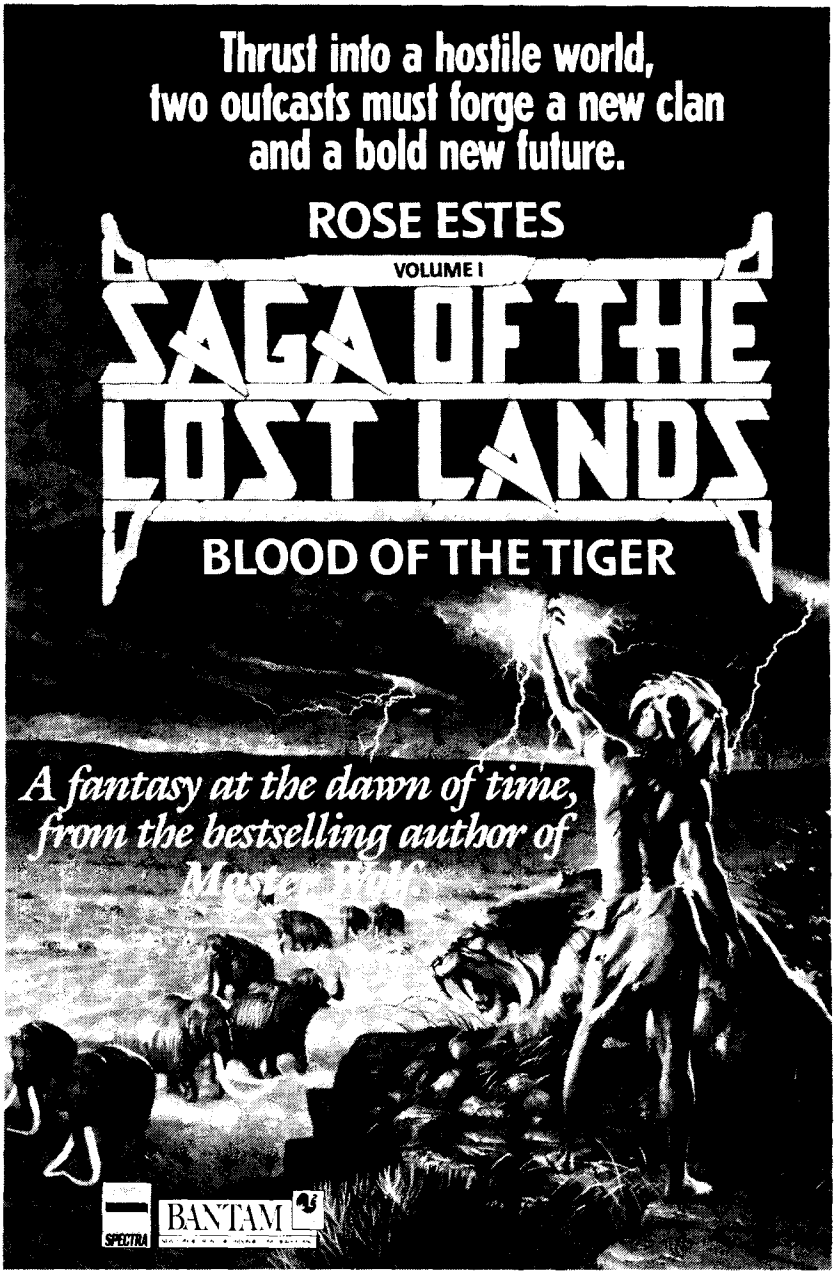
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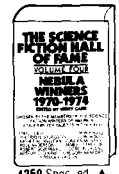

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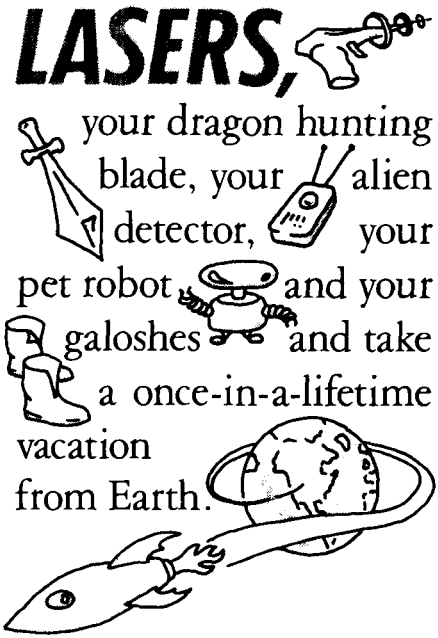

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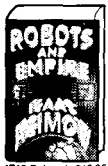

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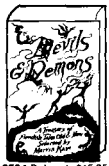

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